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THE INDIAN SCIENCE CONGRESS 1947—DELHI

THE 34th Annual Session of this oldest scientific organisation marks a significant and memorable landmark in the history of the progress of science in India; it is the first and the most representative of the National assembly of scientists to be held after the formation of the Interim National Government. A singularly inspiring feature of this Congress is the fact that Pandit Jawaharlal Nehru, the Vice-President of the Interim Government, who, to quote his own modest words, "represents something of the new India that is rising around us", inaugurated the Session and presided over its deliberations. Pandit Nehru, it will be recalled, was invited to preside over the thirtieth session of the Indian Science Congress in 1943 which was planned to be held at Lucknow. For reasons too well known to need any repetition, Pandit Nehru could not preside over the 1943 Session of the Congress. To quote Professor D. N. Wadia, "Pandit Jawaharlal Nehru's contributions to science in India have not been in the limelight, but they have been leavening influence in the organisation and working of the National Planning Committee which since 1939 is engaged in the great task of co-ordinating applied science with productive industry in every field—industrial, educational, cultural and organisational."

Among the other distinguishing features of the Congress were the Delegations of notable foreign scientists who actively participated in the proceedings of the session. The British Delegation representing a "cross-section of British scientific life" was led by Sir Charles Darwin, the Director of the National Physical Laboratory; the Russian Delegation was headed by Professor M. Volgin, the Vice-President of the Soviet Academy of Science. Eminent men of science representing the United States, Canada and France, were also present at this historic session.

Pandit Nehru established a refreshingly new tradition by commencing his Presidential Address in the language of the land, which was later rounded off in English for the benefit of the visiting scientists. He expressed the hope that now, when India was on the verge of independence and science was coming of age, it would solve the problems of the new India by rapid, planned development on all sectors and try to make her more and more scientific-minded.

Pandit Nehru said, "Surely science was not

merely an individual's search for truth. It was something infinitely more than that if it worked for the community".

Pandit Nehru put forth an impassioned plea for a new orientation of scientific research in this country and emphasised the need for a much more broadbased effort to tap and harness the country's scientific talent in the service of four hundred millions who are faced with the struggle of securing the absolute wants of life. He said:

"For a hungry man truth has little meaning. He wants food. For a hungry man, God has no meaning. He wants food. India is a hungry, starving country, and to talk of truth, God and even many of the fine things of life to millions who are starving is a mockery. We have to find food for them, clothing, housing, education, health—all the absolute necessaries of life that every man should possess. When we have done that, we can philosophise and think of God. So science must think in terms of four hundred million peoples in India. Obviously, you can only think in those terms and work along those lines on the wider scale of co-ordinated planning."

The Science Congress, he said, should devote itself to this imperative task and not wait merely for the Government to take action. He wished to discourage among the scientists a reliance on what the Government may or may not do. He, however, recognised the legitimate right of scientists to expect certain initiatives from the Government. Speaking just as one Member of the present Government of India—partly for his colleagues but largely for himself—Pandit Nehru said, "We are intensely interested in the scientific dvelopment of India and we shall do everything in our power to encourage scientific research. We should like to tap all the latent scientific talent in the country and to give it opportunity for growth and service to the humanity."

The voice of a united India spoke when Pandit Nehru referred to the heralding of the Atomic age with the enactment of the horrible tragedy of Hiroshima. He would pledge to extend his whole-hearted co-operation to the promotion of all aspects of scientific endeavour in every part of the globe, in so far as it advanced the cause of peace, prosperity and happiness for all mankind. "But in giving that undertaking and pledge," declared Pandit Nehru, "I want to make it perfectly clear that we will not co-operate in the ways of war."

"What the future will bring I do not know. I can neither foretell the future nor have I any authority to bind my country down to what it may or may not do in future, but in these days so soon after the last war, when people again think of wars and when scientists are yoked into work in preparation for future wars, I think it is desirable and necessary that men and women of science should also think about the way they are often misused and exploited for base ends. I should make it clear that they do not want to be so exploited."

"Science has its destructive side and a constructive and creative side. Both have gone on side by side and both still go on. No one knows which ultimately will triumph. Hiroshima became a symbol of this conflict and in spite of all the decisions of the Atomic Energy Commission of U.N.O.—and we welcome those decisions of course, in so far as they go—that doubt remains in one's mind as to where we are speeding. On the other hand, apart from the atomic bomb aspect of it, obviously we are on the threshold of a new age, in the sense of enormous power resources being put at the disposal of the humanity and the community. Will this new age change—and I think it will change—enormously the whole structure of society? My mind goes back to the time when gun-powder burst upon the world. Gun-powder at any rate pushed the Middle Ages away completely and fairly rapidly and in course of time brought or helped to bring about a new political and economic structure. Of course, there were many forces at work; nevertheless, gun-powder did produce that powerful effect on society, and ultimately out of that feudal order gradually a new capitalist order developed. Now I wonder whether this so-called atom bomb is not also the herald of a new age, of a new structure of society which has to be established in order to fit in with present conditions. I myself am convinvinced that there is going to be no very great progress either in science or in other ways unless certain fundamental changes take place in the social structure."

Concluding his address, Pandit Nehru said that however engrossed in politics he was, he had always thought or tried to think in terms of a scientific solution for all problems of India. He firmly believed that the only right approach to the world's problems and to India's National problems was the approach of science. He hoped that this historic session of the Indian Science Congress, which had met at a time which is in India's history a very significant time, will prove also very significant in the development of science in India.

THE FUTURE OF SCIENCE IN INDIA

IN a message to the Thirty-fourth Session of the Indian Science Congress, held at Delhi, during the first week of January 1947, Sri. C. Rajagopalachari, Education Minister, Government of India, declared:

"India has in recent times produced eminent men of science, some of whom have found places in the front rank of world scientists. Young men are working in several research institutes in India at problems of first-rate importance. We may be sure that the genius of India will once again find expression in scientific research as it did in ancient times.

In no country in the world did intuition come so near to the discoveries and hypotheses of modern science as the intuition of the philosophers of ancient India. If there is any one centre which we could treat as the earliest starting point from where systematic scientific knowledge spread to all parts of the world, ancient India is entitled to that honour. The amount of astronomical and mathematical knowledge that we find in Sanskrit books is a matter for wonderment. There are some who, instead of tracing the current of knowledge from India through Greece to Arabia and to Europe, would prefer to treat Greece as the source from which India borrowed. Even if this theory should be accepted, it would not be a small achievement for India, for it would mean that the astronomers and mathematicians and men of medicine in India of those days could accept and assimilate such a volume of knowledge from a distant country like Greece. The wave of scientific interest and the application of Indian talent in the progress of science in the present times are, therefore, in accord with the ancient genius of India.

India's acknowledged political leaders also are scientific in their outlook and approach. Those who know Gandhiji intimately will see in everything that he does an uncompromising scientific attitude. He is impatient with inaccuracy and looseness of thought or inference. Even in what may appear to be unmodern in his activities, the true scientists would find in Gandhiji a brother-searcher of truth, who works with such tools as he has in strict accordance with scientific method.

The same is the case with Pandit Jawaharlal Nehru. It is not merely his position in Government that qualifies him to preside over the Delhi Session of the Indian Science Congress. His heart and his intellect throb in resonance with modern science. His taking the chair at the Science Congress and laying the Foundation-Stone of the National Physical Laboratory will give increased stimulus to original scientific research in India concurrent with political rebirth. It will be a source of inspiration and strength to all the young men in the universities who are devoting their talents to scientific studies.

Science, art and culture are not less important than politics. As long as a foreign Power had imposed its rule on us, and a struggle had to be carried on, politics had an inflated value. With freedom, things assume their real proportions. Henceforth politics will not be an obsession dominating and corrupting everything. Science as well as art and culture will be more important than Government or the controversies of politics."

SCIENCE AND INTERNATIONAL CONCORD

WELCOMING the Delegates to the 34th Session of the Indian Science Congress at Delhi, Sir Maurice Gwyer, Vice-Chancellor of the Delhi University and Chairman of the Reception Committee, said:—

"Your visit this year takes place in more than usually auspicious circumstances; first, because this is a moment of great importance in the history of India, when the eyes of the whole country are turned towards Delhi; and secondly, because among those who are joining in our discussions is an exceptionally distinguished body of scientists from other lands; and for these two reasons alone the present session of the Science Congress will always be regarded as a historic event.

I am told that never before have scientists from so many foreign countries met together on the soil of India. They have come from the United Kingdom and the United States, from Canada, from Russia, from France, from China, and from Australia. This is itself a very noteworthy thing, and we in Delhi, appreciate the compliment which it implies. But above all, it is the greatest proof which could be given of the essential unity of science and of the common ground on which men of science, no matter what their race or nationality, are able to meet.

That there is a sphere in which such a common ground exists is no small thing at the present day, and we may all be grateful to the scientists for affording us so inspiring an example of international concord and co-operation. It is a happy augury that it comes to soon after the U.N.E.S.C.O. meeting in Paris, at which the delegates from India, some of whom are here to-day, took so prominent and effective a part.

We have seen in Delhi this week three gatherings of learned men, we have welcomed a Congress of Philosophers, a Congress of those engaged in the study of politics, and to-day we welcome the Science Congress, which embraces them all. All these gatherings, have for their object the pursuit of truth in one form or another; and it might be hard to say which body finds its material the most intractable. Some might say that in the case of the science of politics truth lies at the bottom of a deeper well; but the students of that subject do not regard this fact as presenting any insuperable obstacle to their researches. And it has been an inspiring spectacle to see gatherings of so many men searching for truth in all its many-sided aspects, not for gain or glory, but because truth is to them the most important thing in all the world.

Many of us believe that the future happiness of the world rests largely in the hands of scientists, who are the modern magicians and miracle-workers; it is not their fault that others at times pervert to ignoble uses the gifts which science gives us. It is with this in our thoughts that the University offers them its greetings and its welcome to-day."

Outlining the true function of universities, Sir Maurice declared: "I hope too that this year's meeting of the Science Congress will mark the beginning of a reorientation of the attitude of Indian universities towards scientific studies. There has been, I think, too great a pre-occupation with lectures and degrees, to the prejudice of true learning and research. None denies the importance of learning and research; but there is still room for the more complete recognition of the fact that the greatest and most vital function of a university is to increase the bounds of human knowledge, to be a centre of culture in the broadest sense, to be the guardian of fundamental values and to set the standards for its generation.

This is the true idea and conception of a university not only in India but in every land. To achieve it will be made more easy by the new attitude of the authorities here towards the universities and by the munificent grants which by a welcome change in policy they are now beginning to make.

If the assistance thus generously given is not allowed to prejudice the autonomy of the universities, for that is a precious possession which they could never yield up without being false to everything for which they stand, a future lies before us incomparably greater than anything which the universities have known in the past. They will become what they ought to be, homes for original research and for the promotion of learning, wherein a true academic atmosphere in which intrigue and jealousies have no place, men may have freedom to develop all the talents which God has given them, serving faithfully their own generation and handing on the torch undimmed to the generations which come after."

THE THEORY OF THE FISCHER-TROPSCH SYNTHESIS

BY M. V. C. SASTRI

IN a contribution[1] to the Discussion on "Hydrocarbon Chemistry", held in 1939 by the Faraday Society, London, Dr. S. R. Craxford of the Fuel Research Station, Greenwich, put forward a theory of the Fischer-Tropsch synthesis, depicting the formation of long chain hydrocarbons in essentially three stages, namely: (1) the formation of a carbide-surface (usually cobalt carbide), (2) the limited reduction of the carbide to form long chains of $—CH_2$ groups on the surface, and (3) the disruptive reduction of the CH_2 chains with chemisorbed hydrogen atoms to yield hydrocarbons of suitable molecular weights:

$$(1)\quad 2\,Co + CO + H_2 = Co_2C + H_2O$$

$$(2)\quad H_2 + Co_2C = 2\,Co + -CH_2$$

$$\downarrow \qquad\qquad \downarrow$$

$$(3)\quad ..C-CH_2-(CH_2)_x-CH_2-C.. + 2H = CH_3(CH_2)_x\,CH_3$$

This mechanism has been successful in accounting for most of the phenomena connected with the Fischer-Tropsch synthesis.[1,2] By employing the *ortho-para* hydrogen conversion as a tracer reaction for ascertaining the presence of chemisorbed hydrogen atoms, it was shown that oil formation proceeded only when the surface was almost completely covered by carbide. In the presence of chemisorbed hydrogen, methane was the chief product. Carbide-free surface also facilitated the water-gas-shift reaction

$$(4)\quad CO + H_2O = CO_2 + H_2$$

which accounts for most of the carbon dioxide formed and is obviously an unnecessary side-reaction.

A plentiful accumulation of carbide-centres on the surface of the catalyst is, therefore, essential for maximum yield of oil and this is actually what happens during the so-called "running in" process, in which the freshly reduced catalyst is given a prolonged preliminary treatment with synthesis gas at below the reaction temperature. The importance of the surface-carbide has received further emphasis in two recent papers of Dr. Craxford published by the Faraday Society. In the first paper,[3] it is demonstrated that as the rate of passing the synthesis gas over the catalyst bed is increased the yield of oil passes through a sharp maximum. Simultaneously, the amount of carbon dioxide formed drops abruptly as the velocity is increased beyond the value required for maximum yield of oil. The explanation given is that at low gas-rates oil-synthesis is nearly completed over the first part of the catalyst bed, leaving the succeeding parts free from carbide and, therefore, able to promote the formation of methane and carbon dioxide. At the optimum gas-rate there is obtained a uniform distribution of carbide centres and the whole of the catalyst is thus actively engaged in oil-formation. At higher gas-rates the yield of oil naturally falls off rapidly due to the time of contact with the catalyst surface being too short. With continued use, the catalyst deteriorates, presumably as a result of wax formation and carbon-deposition, so that the surface available for the synthesis and the side reactions alike dwindles continuously. In consequence, the length of the catalyst bed required for good yield of oil becomes greater and greater and the position of the optimum gas-rate shifts in the direction of lower values. This explains why, if the gas-rate is maintained at a steady value below the initial optimum, the yield of oil at first rises to a peak value after a few days' use and then falls off slowly—a result which is quite familiar to experimenters in this field and which is often reported mistakenly as the "rise and fall in the activity of the catalyst". The advantage of conducting the process in stages can also be appreciated in the light of the carbide theory.

In the second paper,[4] the function of the promoters, thoria and kieselguhr, has been examined by kinetic measurements. The results emphasise the salient fact that although the primary consideration for an active Fischer catalyst is a high rate of carbide-formation, this must be coupled with a relatively slow rate of reduction of the carbide in order that oils and not gases may be produced. A catalyst containing cobalt with 18 per cent. thoria and no kieselguhr, in spite of its high rate of carbide formation, is rendered unsuitable by an excessive rate of reduction. On the other hand, a catalyst containing cobalt with 21 per cent. thoria and 100 per cent. kieselguhr is poor in both respects, slow carbidisation and fast reduction. The catalyst commonly used containing cobalt with 18 per cent. thoria and 100 per cent. kieselguhr has a relatively rapid carbide formation which, together with slow reduction, accounts for good yields of oil.

The emphasis placed so strongly on the importance of surface-carbides should not obscure the equally important role of chemisorbed hydrogen atoms which, though relatively few in number, are no less vital to the formation of oil. The fragmentation of the giant chains of $-CH_2$ groups chemisorbed on the surface into hydrocarbon molecules of suitable size is due to attack by these hydrogen atoms, as shown in reaction (3) above. Lack of chemisorbed hydrogen would result in the formation of waxes of indefinitely large molecular weight, with consequent deterioration of the catalyst, while an excess of it would lead to gaseous products.

The importance of chemisorbed hydrogen in the Fischer-Tropsch synthesis has been brought out more eloquently by the recent work of Sir J. C. Ghosh at the Indian Institute of Science, Bangalore. By incorporating 4 to 5 per cent. of chromium oxide in a typical cobalt-thoria-kieselguhr catalyst, very good yields of oil have been obtained, using water-gas as such without the usual addition of hydrogen.[5] The gain in economy that accrues from this development is obvious. Chromium oxide is a powerful chemisorbent for hydrogen and acts presumably as a "surface-enricher" for hydrogen, helping to maintain the necessary concentration of active hydrogen at the seat of the reaction, while at the same time allowing a higher partial pressure of carbon monoxide in the gas-phase. That this is so in fact is borne out by adsorption measurements.

1. Craxford, S.R., *Trans. Faraday Soc.*, 1939, **35**, 946. 2. Herington E. F. G., and Woolward, L. A., *ibid.*, p. 958. 3. —, *ibid.*, 1946, **42**, 576. 4. —, *ibid.*, p. 580. 5. Ghosh, J. C., and Sastry, S. L., *Nature*, 1945, **156**, 506.

COCONUT SHELLS AS AN INDUSTRIAL RAW MATERIAL
IV. COCONUT SHELL CHARCOAL: (B) ACTIVATED CARBON

By Dr. REGINALD CHILD

(Director, Coconut Research Scheme, Ceylon)

THE first part[67] of this the fourth article of the series dealt with Coconut Shell Charcoal so far as concerned the preparation of the crude (primary) charcoal and some of its uses. Only brief reference was made to its principal application as "activated carbon".

A general account of activated carbon is not here possible. What is attempted is a discussion of the position coconut shell charcoal occupies in this field. References to the more important published reviews of the general subject are given.[68–76]

The power of freshly made wood charcoal to absorb gases was certainly known in the late eighteenth century, as was its property of removing colouring matter and impurities from solutions. The volumes of different gases absorbed by a unit volume of charcoal were measured by Th. de Saussure[77] (1814) and his figures are still quoted, often without acknowledgement or any indication of their date.[77a] It was known, too, that charcoals from different woods varied considerably in their absorptive capacity (*cf.* Brande, 1821)[78]

The superiority of coconut shell charcoal was established by J. Hunter, who published between 1863 and 1872 a series of papers[79] on the absorption of gases and vapours by charcoal. Since then it has been utilised in many researches, both academic and applied. Dewar observed the extraordinary absorptive power of coconut charcoal at low temperatures and applied this property to the production of high vacua and the separation of gases.[80] Rutherford used the same method in his work on radium emanation and J. J. Thomson testified that Dewar's method of exhaustion by strongly cooled charcoal had been almost a main contributory cause to the progress of modern physics.[81]

Although it is only since the war of 1914-18 that activated carbons have been widely developed industrially, there were prior to this a number of scattered observations on "activation". Thus de Saussure's boxwood charcoal samples were heated to redness and cooled under mercury before each absorption measurement. De Bussy[82] in 1827 described several methods of increasing the decolorizing power of vegetable charcoals. An early example of "chemical activation", using metal chlorides, is that of Ostrejko (1900).[83] Halse (1903) similarly employed sulphuric acid.[84] Dewar's coconut charcoal was steam activated; an interesting discussion of the nature of Dewar's charcoal has been given by Hass *et al.* (1939).[85]

Reference has been made in the previous article[67,49] to the developments in 1914-18, when active carbons were required for gas masks. Accounts of the work of the U.S. Chemical Warfare Service were published in 1919 by Dorsey[86] and by Lamb *et al.*[87] Preliminary experiments had shown that the activity of charcoal increased with the apparent

density of the raw material; of fifty or more materials investigated, coconut shells had the highest density and gave the most active charcoal. As supplies of coconut shells were limited by transport difficulties other raw materials were also used in practice, including various nut materials such as cohune nuts, cherry stones, apricot stones and vegetable ivory, and (later) anthracite coal. These papers carry photomicrographs of interest including some of coconut shell, primary charcoal and charcoal at various stages of activation.

It was briefly mentioned in the previous article[67] that preliminary investigations had been carried out in coconut-producing countries on the possible local production of active carbons. In the Philippines the subject was studied, especially by Clemente and his colleagues at the University. In 1930[88] experimental results were published on the relative adsorption of acids and bases from aqueous solution by forty-one different kinds of Philippine wood charcoal (not chemically treated). Coconut shell charcoal had the highest adsorption for potassium hydroxide and the lowest for hydrochloric and acetic acids. Decolorizing charcoals were prepared by Clemente and Pascual (1939)[89] from coconut shells, husks and cake, by impregnating with zinc chloride and carbonizing. Tested by their adsorption of Sudan III from kerosene and methylene blue from aqueous solution they were about as active as Norit. Charcoal prepared by other treatments were less effective. Clemente and Galang[90] prepared active charcoals by the zinc chloride method from various agricultural by-products, including coconut shells, and compared their adsorption of methylene blue, Congo red, methyl-violet and iodine from aqueous solutions and of colour from coconut oil; the adsorptive properties of these charcoals for vapours of ether, benzene, alcohol and chloroform were also studied.[91] Similar work was reported by Samaniego and de Leon (1940),[92] who prepared charcoals activated in various ways from rice bran, rice hulls, coconut shells, corn-cobs, lumbang* (candlenut) shells and pilinut† shells. The best decolorizing carbon, as estimated by its adsorption of iodine, was coconut shell charcoal prepared by impregnating with phosphoric acid; satisfactory gas adsorbents were obtained from all three nut shells impregnated with caustic soda. It was stated in 1939[50] that there was then no commercial production in the Phillipines of activated carbon from coconut shell charcoal. The "Cochar" Products Inc., were, however, stated to be ready to undertake production if a market could be found; the Company were understood to have patented a process utilizing the combustible gases from the primary carbonization to make the activated carbon (see below).

Rao in India (1939)[93] studied various raw materials, including coconut shells, as sources of active charcoal suitable for sugar refining. Satisfactory gas adsorbent charcoal was prepared by Neubauer and Rands[94] in New Zealand by steam activation of crude coconut charcoal from Samoa. Similar laboratory scale work is believed to have been carried out by the Department of Commerce and Industries in Ceylon but nothing has been published.

Methods of Preparation

Methods of preparation of decolorizing carbons have been classified by Mantell (*loc. cit.*, 1941, 1298-99) as follows:—

Class 1.—Carbon is deposited on a porous inorganic base to produce materials analogous to bone chars. Natural high-ash products such as rice hulls, which contain an appreciable amount of silica, may be used directly as raw material (*cf.* Clemente's work in the Philippines). Vegetable materials such as saw-dust, sea-weed, bagasse, etc., may be mixed with porous substances such as pumice or diatomite; the mixture is strongly heated whereby the carbon is deposited throughout the porous base.

Class 2. Impregnation Methods.—Suitable carbonizible materials are impregnated with chemical reagents such as sulphuric acid, phosphoric acid, metallic (especially zinc) chlorides, etc; after carbonization at comparatively low temperatures, the resultant carbons are washed free from inorganic compounds. A second carbonization is sometimes given.

Class 3.—Primary charcoals are prepared by heating suitable materials (wood, lignite, waste sulphite liquors, etc.) in retorts. The properties of the final carbons vary considerably with the conditions of carbonization. The primary charcoals are activated by air, oxides of carbon, chlorine, superheated steam, or mixtures of steam and air, the effect being one of selective removal of the residual hydrocarbons on the internal surfaces of the charcoal. When oxides of carbon are employed there may be re-deposition of active carbon on the surfaces of the material undergoing activation (*cf.* the Cochar process mentioned above).

The preparation of gas-adsorbent carbons usually follows the lines of class 3. Further information on laboratory and commercial methods will be found in the references given.[68-76]

The dense hard charcoals derived from coconut and similar "nut" shells, whilst pre-eminent as gas adsorbents, are not generally so effective in decolorizing solutions, for which purpose soft and highly porous carbons are preferred. Chaney, Ray and St. John (1923)[95] attempted to correlate decolorizing and gas-adsorptive efficiencies; but there is considerable specificity in adsorptive action in liquids; a charcoal active in decolorizing one type of solution will not necessarily be equally effective in other types.

Methods of Examination

(*a*) *Gas-Adsorbent Carbons*—

Particular attention may be drawn to a useful paper by Stone and Clinton (1942).[96] The most reliable data for assessing the efficiency of gas-adsorbing carbons are:—

(1) *Service time*, which is the time required for the break through of a vapour (usually chloropicrin) under specified standard conditoins.

(2) *Adsorption Value.*—The weight of a vapour (usually carbon tetrachloride) adsorbed by a carbon under conditions of saturation.

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* *Aleurites moluccana*, Willd.

† *Canarium ovatum*, Engl.

(3) *Retentivity.*—The residual weight of vapour retained under standard conditions of temperature and pressure. Stone and Clinton correlate these with the heat of wetting in *m*-xylene for coconut carbons and provide a convenient method for evaluating them on this basis.

(*b*) *Decolorizing Carbons*—

Mantell (*loc. cit.*, 1941, p. 1300) states that "in the present state of our knowledge, data regarding the action of carbons on one solution cannot be applied to a different solution, but each one to be decolorized must be tested separately. The so-called standard methods of estimation have little practical value".

Density of Activated Coconut Shell Charcoal.—The *apparent density* (gms. per ml.) is generally measured on dry samples screened between 8 and 14-mesh. Stone and Clinton (*loc. cit.*) quote a range of 0·38-0·54 for gas-adsorbing carbons derived from coconut shells.

The true density tends to a limit of 2·1[97] (graphite has s.g. 2·25).

Industrial Applications.—The dry distillation products of coconut shells form the subject of the next article projected in this series. The prospects of an industry based on coconut shell distillation depend largely on the existence of a satisfactory outlet for the charcoal.

In the past the demand for coconut shell charcoal has been for the preparation of gas-adsorbent carbons for war purposes, and there is reason to suppose that the bulk of the nearly sixty thousand tons of crude charcoal exported from Ceylon between 1937 and 1940 inclusive was so utilized. As a supplement to the table showing exports of shell charcoal from Ceylon (1933-41) which appeared in the previous article,[67] the following table gives the exports from 1942-45.

TABLE I

Exports of Coconut Shell Charcoal (crude) from Ceylon

Year	Amount Tons	Value Rs.	Value per Ton Rs.
1942	2,334	111,422	47·74
1943	1,562	94,044	60·21
1944	470	29,900	63·62
1945	1	70	70·00

Industrial uses of gas-adsorbent carbons include: purifying carbon dioxide from fermentation processes; purifying air; solvent recovery in extraction and similar plants; recovery of gasoline from natural gas and benzene from coal gas; and in vacuum work, *e.g.*, manufacture of radio valves, X-ray tubes, etc.

Decolorizing carbons are used in water purification, refining of edible oils, and the purification of such materials as glycerine and pharmaceutical chemicals. The largest potential application is in sugar refining; the refining process using bone charcoal is very old-established, but in recent years activated vegetable carbons have been found capable of handling economically smaller outputs than the char process and involving less capital investment on equipment and buildings.

Alkali-activated charcoals can be prepared which are able to remove metals such as gold from their solutions. Avery (1908)[98] used coconut shell charcoal in an investigation of the decomposition of gold chloride in this manner.

Active carbons act as contact catalysts in a number of chemical reactions of industrial importance. Hassler (*loc. cit.*, pp. 56, 111-113) gives examples and a bibliography.

There is an extensive literature, both in technical journals and in patent records, on active carbons. This is useful on industrial applications, but less so on methods of preparation. It is probable that much information is unpublished in the records of firms actually engaged in manufacture.

Previous articles in this series have been :—

17. Child, R., "Coconut Shells as an Industrial Raw Material. I. Composition of Shells." *Curr. Sci.*, 1943, **12,** 292-94.

(See this article for references 1-16).

31. Child, R. II. "Miscellaneous uses: Fuel." *Ibid.*, 1944, **13,** 4-6. (for references 17-30).

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APODOUS AMPHIBIA OF THE EASTERN GHATS, SOUTH INDIA

By Dr. L. S. Ramaswami

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Herpetologists have reported the occurrence of Apoda (Amphibia) from the Western Ghats of India, and as far as I know, there is no similar record from the Eastern Ghats.

The Western Ghats stretch from Cape Camorin to the Tapti Valley and the Palni Hills are an easterly extension of the same. Mysore and Coorg have on their western margin these Ghats from where specimens of Apoda (Ichthyophis and Gegenophis) are procured. South of Mysore, the Western and Eastern Ghats meet forming the Nilgiri Hills. The Eastern Ghats are not such a continuous stretch as the Western and extend away from the coast, from Orissa to Nellore on the east coast, the Nallamalai, Nagari and Javadi Hills and the Shevroys forming parts of this chain. The average altitude of the Eastern Ghats is about 2,000 feet.

Nagalapuram Hills (Text-Fig. 1) are isolated in the north-western corner of Tiruvallur taluq, Chingleput district, to the east of Nagari Hills extending into the Kalahasti zamindari. Kambakkam reserved forest is a part of this hill and at the foot of the Kambakkam Hill, as it is locally known, there is a forest Rest House called Thantipandal (about 340 feet above sea-level). Opposite the hut, is a small pool of water near which a well-grown specimen of *Ichthyophis monochrous* (Bleek.) was collected by me. However, there was a white patch, behind the eyes, running from one side of the head to the other which is not present in specimens from the Western Ghats.

About four furlongs from the hut, there is a Dry Cow Salvage Station, instituted by the Madras Government, and opposite this is a brook which supplies water to the station,

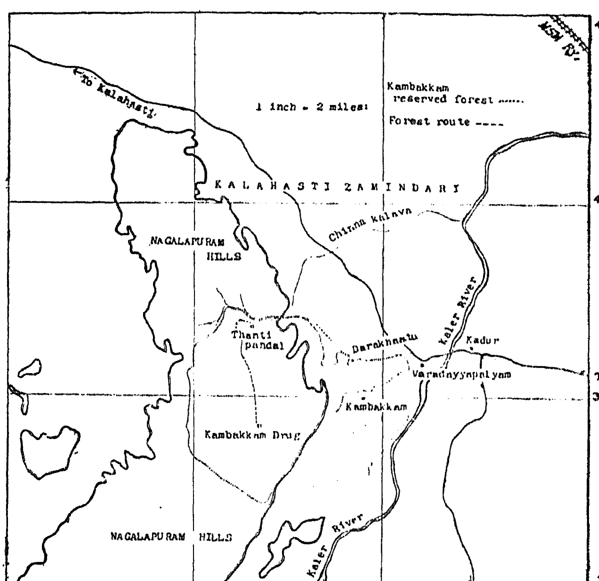

FIG. 1. Map of Kambakkam reserved forest area (after Survey of India map nr. 57-0 /ne) in Nagalapuram Hills, Eastern Ghats.

The stream was diverted and the loose soil overgrown with grass was pulled out and a number of larvæ of *Ichthyophis monochrous* secured. It is interesting to note that these animals breed even during cold months also.

Dr. F. H. Gravely who was the first to collect two apodan specimens from Kambakkam locality sent them to America and I learn that they are still unidentified. In his letter, Dr. Gravely

stated that the specimens were secured "from under a dead log beside the mountain stream at Kambakkam in the valley between its fall from a higher altitude to low level and the canebrake near Tantipandal. If I remember rightly it was not much below the fall". The area to which Dr. Gravely refers is away in the jungle from where I collected. I showed my specimens to him but he was unable to say whether his resembled mine.

These primitive Amphibia have hitherto been unknown from the Eastern Ghats and no description of the larvæ of *I. monochrous* exists. The available literature shows that the larvæ of both *I. glutinosus* and *I. monochrous* are mixed up in description. A comparison of the larval stages of *I. glutinosus* and *I. monochrous* shows that the latter larvæ can be easily distinguished from those of its congener.

Late embryos of *I. glutinosus* show the presence of three pairs of external gills and also a 'spiraculum' in which *two* projections are noticeable between which a single cleft opens. In the aquatic larvæ where the external gills have been absorbed, the 'spiraculum' shows the two projections with a cleft in between them. Gadow,[1] however, described correctly the structure of the 'spiraculum' as above. The yellow band, so characteristic of the species appears only after the larva has grown a little; in a larva measuring 79-80 mm. there are no bands while in that measuring 82-85 mm. the bands are just visible. However, Sarasins,[2] confirming the observations of Müller, noted *three* projections in the 'spiraculum' of *glutinosus* corresponding with the second, third and fourth ceratobranchials, and two gill slits between the second and the third and the third and fourth arches respectively. In his descriptions of early larval stages of *glutinosus*, Deraniyagala[3] noticed that in a larva measuring 94-96 mm. each 'spiraculum' disclosed three vestigial branchial arches and he delineated three projections in the 'spiraculum' in his Figs. 1 and 2 (Plate XXXVII). In a stage which he characterised as the next during metamorphosis of this species ('terrestrial larva', 157 mm. long) he recorded that the 'spiraculum' showed only *two* vestigial branchial arches but no reference has been made to the number of slits either in this or in his previous 'aquatic' larval stage.

Boulenger[4] in describing the systematics of Apoda, draws figures of the larvæ of *I. monochrous* (Pl. IV, Fig. 1-1c); in the profile of the head, the figure seems to show only two projections in the 'spiraculum' and the exact number of annuli intercepted by the anus could not be made out in Fig. 1c.

In a sectional view of a larva described as belonging to *I. glutinosus*, Norris and Hughes[5] show the second gill slit passing evidently between the third and fourth branchial arches since a portion of the fourth branchial arch is also depicted. These authors are also describing a larva with two pairs of gill slits.

Since the yellow bands are not formed in the early larvæ of *I. glutinosus*, it is possible that the collections of Sarasins and of Deraniyagala contain larval forms of both species of *Ichthyophis* which could not thus be differentiated and the latter author has, therefore, regarded those with three projections as an earlier aquatic larval stage of *glutinosus*. Further, while Sarasins show three projections in some figures (Pl. XXIV, Figs. 119, 120) and sectional views (Figs. 121, 122), only two plate-like structures are depicted in Figs. 48 and 51 (Pl. V); obviously the collection is a mixed one.

After examining a closely graded series of embryos (egg clusters with mothers) and larvæ of *I. glutinosus* from Kotgehar (Mysore State) and having sectioned stages earlier than those studied by Deraniyagala, I am unable to corroborate the observations of Sarasins and of Deraniyagala with regard to the number of projections and slits.

The characters of the larvæ of *Ichthyophis monochrous* and *Ichthyophis glutinosus* can now be described as follows:—

I. monochrous (Bleeker): Larva studied 200 mm. in length with a very prominent tail fin, the dorsal lobe of which extends in front of the anus; snout length less than the inter orbit; no yellow bands, a uniform steel blue; head shows thick lips, two milky eyes with a tentacular orifice in front of each eye (even in a larva measuring 100 mm., the smallest that I possess, this orifice is present); sensory openings on the head; 322-325 rings on the body; the cloacal opening interrupts seven annuli; eight postanal annuli and a small posterior

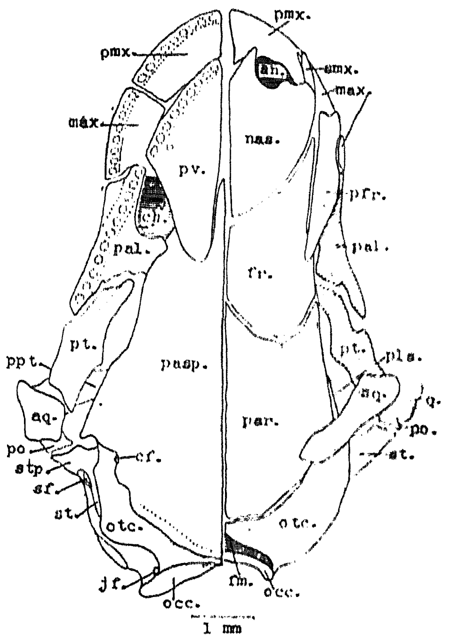

FIG. 2. Skull of a larva of *Ichthyophis monochrous* (Bleck.) (ventral aspect on left side).

an., anterior naris; *aq.*, articular facet of quadrate; *cf.*, carotid foramen; *ch.*, choana; *fm.*, foramen magnum; *fr.*, frontal; *jf.*, jugular foramen; *mx.*, maxilla; *nas.*, nasal; *occ.*, occipital condyle; *otc.*, otic capsule; *pal.*, palatine; *par.*, parietal; *pasp.*, parasphenoid; *pfr.*, prefrontal; *pls.*, pleurosphenoid *pmx.*, premaxilla; *po.*, processus oticus; *ppt.*, processus pterygoideus; *pt.*, pterygoid; *pv.*, prevomer; *q.*, quadrate.

portion; 'spiraculum' with *three* projections and *two* clefts in between; a mucus pit, in some, in front of the 'spiraculum'; scales in the dermis. The skull (Text-Fig. 2) shows a temporal gap on account of the incomplete growth of the squamosal (*sq.*); a post-frontal is wanting; palatine (*pal.*) separate from maxilla (*max.*); palatine teeth 11, maxillary 8, prevomerine 9 and premaxillary 9; the maxillary and palatine teeth rows are unequal, the latter extending behind the choana more than the former; the lower jaw carries two rows of teeth, the inner row short; the stapedial artery pierces the columella (*sf.*); the ceratohyals and the first two pairs of ceratobranchials are connected mesially by basihyal and copula 1 and 2 respectively; the fourth ceratobranchial is small and articulates at the middle of the third ceratobranchial; the gill clefts are between the second and the third and the third and fourth arches respectively.

I. glutinosus (Linné): Larva studied 130 mm. long with a tail fin shorter than in *monochrous* and with a dorsal lobe as in *monochrous*; snout length more than the interorbit; yellow bands on the sides extending from the sides of the head; head shows two eyes with a tentacular orifice in front of each eye, but in a larva measuring 101 mm. this orifice is not yet formed; sensory openings on the head; the cloacal opening interrupts five annuli; 3-4 postanal annuli and a short postanal portion; 'spiraculum' shows only *two* projections with a cleft between them.

The skull shows a temporal gap on account of the incomplete growth of the squamosal; a postfrontal wanting; palatine and maxilla separate; stapedial artery pierces the columella; the hyobranchial apparatus is as in *monochrous* and the only gill slit is noticed between the third and fourth ceratobranchials.

Thus when the yellow bands have not yet appeared in *glutinosus*, the *monochrous* larvæ can be differentiated from the former by the possession of (1) a 'spiraculum' showing three projections and two clefts and of (2) a snout shorter than the interorbit. In older larvæ, the annuli become clearer and in *monochrous*, the anus interrupts seven annuli.

I must express my sincere thanks to Dr. A. Aiyappan, Superintendent of the Government Museum, Madras, for affording facilities which enabled me to explore the Kambakkam Hills. I am also thankful to Mr. P. E. P. Deraniyagala of Ceylon for kindly going through my material and offering useful suggestions. To the authorities of the University of Mysore, I am deeply indebted for defraying the cost of two expeditions to the Kambakkam forest.

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ERADICATION OF INSECT PESTS OF STORED GRAINS RATHER THAN THEIR CONTROL*

By M. MAQSUD NASIR, M.Sc. (Ag.)
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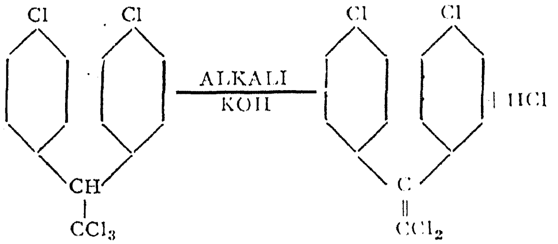
I. General

THE urgency of the need of an effective control of harmful insects was felt in the World War when every effort was directed to produce more food and to save as much as possible from the ravages of insects in order to avert the threatening world-wide food shortage. With unceasing search and never getting disappointed with their efforts in the advancement of science and perfection of the known and discovered things, the scientists were able to bring to light the spectacular insecticidal properties of the two substances, *viz.*, Dichlorodiphenyltrichloroethane and Benzenehexachloride which remained undiscovered till then. The application of these has not been perfected and still needs careful investigation. However, on the basis of whatever achievements have been affected uptil now, it can be safely predicted that the control of the agricultural crop pests is definitely going to be revolutionised and become less complicated. We hope that time is not far off when we shall claim eradication of insect plagues rather than their control. Already a good deal of contribution has been made by the scientists all over the world but the prohibitive cost and the non-availability of the insecticides have restricted their trial and use in India. Such factors are, however, considered of little importance and value when the study of the scope of a new insecticide is in progress. For instance, methyl bromide was considered to be a costly fumigant till 1938 (fumigation properties discovered in 1934-35) but its inherent valuable properties made it possible after some time to procure it at cheaper and economical price, thereby helping in its extensive use in the present days. In India these new insecticides have been tested extensively against mosquitoes, flies, sand-flies, lice, etc. Their use in agriculture is slowly finding its way and co-ordinated attempts have so far been instituted to find out their practical application in the control of

*A simple method for the control of insect pests of stored grains and potato tuber-moth by the use of DDT and 666 has been evolved.

stored grain pests. The urgency of their use in this line was realised when it was made known to the public that the stored food-grains in India are undergoing an undetectable loss of 3·375 million tons of food, sufficient to feed 6 million persons for full one year. A meeting of all Entomologists in India was called by the Food Department, Government of India, to plan out the proper application of the chemicals (DDT and 666) in respect of combating the stored grain pests. The Entomologist from the Ordnance Laboratories, Cawnpore, while reviewing his researches about the application of the insecticides as debris disinfectants and in whitewash† for disinfecting godowns, put forth his interesting conclusions on whitewashing of godowns for the control of stored grain pests. These inferences were, however, identical to those of the writer arrived at independently as a result of research on similar lines at the Imperial Agricultural Research Institute, New Delhi, under the then Director, Dr. Hem Singh Pruthi. These are :—

(1) Lime inactivates the two insecticides causing dehydrohalogenation. The chemical change is rapid in DDT and is as follows :



Dichlorodiphenyltrichloroethane — *Dichlorodiphenyldichloroethylene*

(2) Chalk, although a neutral substance, has got the limitations of being costly and not easily available. Further it does not form a good wash.

(3) The particles of chalk and lime cover to a considerable degree the minute particles of DDT and 666, never allowing the covered particles to play their role.

(4) Particle size plays fundamental part in case of all nerve poisons. The most effective size is 5 microns. This much size of the particles can be obtained on evaporation of the solvent from the solution or emulsion.

It is, therefore, quite evident from the above that the whitewashing experiments would be of little use for the chances of killing insects to an appreciable degree are remote. The only possibility for the application of these insecticides on the walls is to apply them as spray in petrol, kerosin oil, etc. The writer consequently considered it worthwhile to give up the idea of pursuing the whitewashing treatment. To support the contention further, it may be added that few insects crawl on the walls of a godown packed with bags of grains unless the grains are disturbed, the temperature is very high, the insects are in enormously large numbers or the percentage of infestation exceeds fifty. Some of the conditions enumerated above appear at a stage when grains become totally unfit for consumption thereby rendering the treatment of little use, while the remaining ones that occur occasionally are difficult to secure. Hence again the utility of the treatment is not encouraging. It may, however, be mentioned at this stage that whitewashing could be employed for disinfection of empty godowns where insect-free produce is likely to be stored. The possibility of disinfection under the above conditions can be ruled out to some extent for it is easy to disinfect by sulphur fumes or HCN, this treatment will not only be convenient but effective also. However, with all the points unpropitious whitewashing may be adopted for treating underground godowns or *khattis,* where fumigation is a problem. But seldom there is necessity of disinfecting an improvised bin as the damage in it is always negligible. Here too, the spraying of a solution or emulsion would be advisable.

The writer thus restricted his attempts in finding out an easy method by which an attack of insects to sound and healthy grains may be warded off effectively and also infestations present to a certain degree may be eliminated with special reference to storage in bags. Holding of grains in bags is convenient and hence unavoidable and indispensable although unfortunately the damage due to insects is considerable because of the easy access of the pests. The experiments together with the inferences are set forth in the following pages.

II. Experiments

Gunny bags, half of the standard size, were treated with the following solutions and emulsions of DDT and 666.

(1) *Seven, 14 and 28 per cent. mixtures in Kerosin oil.*—100 c.c. of each mixture was used for treating inner and outer surfaces of four bags.

(2) 0·35, 0·7 *and* 1·4 *per cent. mixtures in water.*—2000 c.c. of the preparation was used to soak four bags. The poisons were first diluted with chalk so as to remove their stickiness and also to help in their uniform dispersion.

(3) *Kerosin oil emulsion containing* 0·35, 0·7 *and* 1·4 *per cent. poisons.*—2000 c.c. of the preparation was utilised in treating four bags. Kerosin oil emulsion was prepared by using gum as emulsifier.

(4) *DDT and* 666 *emulsions*‡ were prepared as follows : DDT or 666 25 gms., Toluene or Benzene 33·35 gms., Turpentine 33·35 gms., Water 0·6 gms., Soap 2·8 gms. Alcohol 4·9 gms. The stock solution was first diluted with four times water and then the whole quantity made upto 7000 c.c. Only 2000 c.c. of the emulsion thus prepared was used in treating four bags only.

In all there were 22 treatments and one control. Each treatment was replicated four times. The minimum dose tried was 1·7 gms. of the poisons per bag. The bags were treated on 24|25-3-1945 and then thoroughly dried up in shade. Five seers of insect-free jowar (*Andropogon sorghum*) grains were put in each

† DDT and 666 were used in white wash at the rate of 2·5, 5·0, 10·0 and 15·0 mgrms. per sq. ft.

‡ This treatment was done in August when the ready material was made available by the Director, Malarial Institute, Delhi.

bag on 31-3-1945 and kept in a godown heavily infested with all the species of insect pests of stored grains by keeping infested grains in corners. The control lots were kept away at a distance of more than five feet from the treated ones. Two more treatments were added after a lapse of one month where DDT and 666 carried in chalk were mixed with grains at the rate of 1 in 10,000. On 16-4-1945, 25 adults of each *Sitophilus oryzæ* Linn., *Rhizopertha dominica* Fab., *Tribolium castaneum* Hbst., *Corcyra cephalonica* Staint., *Sitotroga cerealella* Oliv., and *Latheticus oryzæ* Waterh., were introduced in one replication of each treatment. The observations were taken fortnightly till the 15th of May and later on after a lapse of full one month.

III. Results

Record of the sweepings are given below in a tabular form :—

Date of observation	Sweeping from the area where treated bags were kept								Sweepings from the area of control lots
	Wt. of dead insects in grams	Percentage of insects in the sweepings (by number)							
		S.o.	R.d.	T.c.	L.o	S.c.	L.s.	Misc.	Wt. of dead insects in gms.
16 4-1945	9·2	58·0	3·4	6·3	12·6	12·5	4·1	3·1	0
30-4-1945	15·3	59·1	4·7	15·2	8·6	11·2	0·1	1·1	0·2
15-5-1945	24·35	27·6	5·1	20·4	8·1	2·1	33·6	3·1	0
30-5-1945	21·5	14·1	11·1	36·0	11·7	3·2	13·8	7·1	0·1
30-6-1945	15·6	6·8	22·4	28·5	20·2	5·6	12·3	4·2	0
30-7-1945	7·5	2·1	30·5	23·7	16·3	12·5	4·1	10·8	0
30-8-194·	5·3	0·2	62·1	14·3	11·4	10·2	0·5	1·3	0
30-9-1945	2·4	—	—	—	—	—	—	—	0

(S.o.—*Sitophilus oryzæ* ; R.d.—*Rhizopertha dominica* ; T.c.—*Tribolium castaneum* ; L.o.—*Latheticus oryzæ* ; S.c.—*Sitotroga cerealella* ; L.s.—*Læmophlœus* spp. ; Misc.—*Corcyra cephalonica, Silvanus surinamensis, Alphitobius* sp., etc.)

In a couple of days after putting the bags in the godown, it was observed that the insects were dying in large numbers on and in the vicinity of each bag of the treated lot. A good number of insects were seen in a state of paresis and the peculiar effect of DDT or 666 causing the stretching of wings and legs as a result of nerve poisoning was also noticed in all the dead and paralysed adults. It will be seen from the above table that the mortality percentage increased immediately but declined slowly till the end of September when very few insects died. On examining the heap of infested grains (used as a source of infestation for the room), it was observed that practically the infestation was nil as compared to the one in March on account of regular drain of insects to the experimental lots.

On 15-10-1945, the grains in each bag were weighed and examined for percentage of infestation. It was interesting to note that no living or dead insect could be collected from the treated lots. Even in case of those bags where insects were actually introduced for the sake of infestation in the grains neither the damage nor any living insect could be observed. Similar observations were recorded in replications where the poisons were used as preservatives, but here the number of dead insects inside the bags was very large. Examinations of the control lots on the other hand revealed that they were full of living insects and the grains had suffered heavily to an extent of 50-70 per cent.

For further confirmation of observations as regards the annulling of development where infestations were made in the bags, some insects numbering 50, each of *Sitophilus oryzæ*, *Rhizopertha dominica*, *Tribolium castaneum*, *Corcyra cephalonica* and *Sitotroga cerealella* were caged in dishes, size 4" × 2", containing grains over DDT or 666 powder put in similar dishes, separating the two dishes by means of muslin cloth. The insects were not allowed to come in direct contact with the poisons. It was observed that all the insects died in 7-14 days' time whereas in the control lots they lived on without mortality.

It is, therefore, evident from above that DDT and 666 give out vapours which also kill insects ; hence both the poisons appear to act as contact poisons as well as slow fumigants.

IV. Discussion

It is established that DDT and 666 would be of little use in whitewash where the intention is to reduce infestations by warding off insect attack. From the foregoing experiments and results, it is evident that if bags are treated with these poisons, grains remain safe not only from the outside infestations but the infestations already present can also be annulled as the poisons act as slow fumigants as well. Of all the treatments, the application of kerosin oil mixture is easy to perform and yields promising results. It was found out by experience that while treating bags more attention is required to be directed at corners and sewn areas which appear to be vulnerable points. The least dose tried was 1·7 gms. per half the size of a standard bag, *i.e.*, 3·4 gms. per bag which remains effective for 6 months and it has been learnt that the effectiveness persists almost unimpaired even after a lapse of full twelve months. The cost of the treatment works out at 2·1 annas per bag and this figure is very low in comparison to the average loss (Re. 1 per bag of grains) sustained through insects. The cost can be further reduced by experimenting with low doses and correlating them with period for effectiveness. The other treatments have got a disadvantage of entailing extra four or five days because of drying of individual bags but are useful in not leaving any undesirable smell. In this respect

insecticides dissolved in petrol, benzene, etc., would be better if applied with a spray pump. However, it rests with individual convenience as to which treatment can be employed but it would be advisable if only one treatment is followed universally. The suggested treatment as it stands, appears to entail a huge amount of labour, etc., and will be difficult to practise in all channels of grain movements because of the conservativeness unless some law is enacted to force people to undertake the treatment. The movements of bags which are indispensable in trade, is the factor that renders this treatment complicated.

To simplify and make the treatment attractive by removing the possible shortcomings, it can, however, be suggested for transience that big sheets of gunny cloth may be treated and used as cover for individual stacks. These sheets should also be spread under each stack so as to eliminate access of insects through creeping along the floor. This type of modification in the treatment is bound to be equally effective, especially in case of insect infestations in grains lying in open heaps in a godown or *khatti*. The scope of this treatment can be extended over receptacles like *dholi*, *bokhari*, *kothi*, etc. In such receptacles generally the top layers get infested and these can be easily protected by using a cover of treated gunny cloth. As an additional precaution, an extra sheet can be kept at a distance of four inches below the top, this will add to the efficiency of the treatment. In the Punjab and some other parts of India where *theka*, *theki*, *palla*, *palli*, etc., prepared out of gunny cloth, are in vogue to store 20-200 maunds of grains, the application of poisons as suggested in this paper, can be advocated with advantage. For rendering godowns immune to insect access, barriers of treated gunny cloth can be put on windows and ventilators and further doors and gates can be provided with curtains of the some; the use of fine wire-gauge can thus be eliminated. Spraying DDT or 666 emulsion inside godowns will further add to security against insect ravages.

Spreading of treated gunny over grain heaps appears to work nicely against *khapra*. In laboratory trials, *khapra* grubs have been found very resistant to the poisons but their beetles are very susceptible.

It may also be indicated that by adoption of this treatment, *i.e.*, use of treated gunny cloth, there will be a great relief from the nuisance of potato tuber moth, *Gnorischema operculella* and bruchids. Only a thin gunny cloth as a cover will suffice for an effective control. A trial on a small scale was conducted at the Imperial Agricultural Research Institute, New Delhi, and encouraging results were obtained.

The application of DDT and 666 presented in the paper has given marvellous results in the control of a number of pests and needs further investigations as to its scope against similar insects. It is also suggested that the findings contained in this paper may be tested on a large scale keeping at least 200-400 bags in a test, in places where facilities exist, *e.g.*, at Government Farms and results watched for full one season. The following different treatments can be included in the proposed trial:

(1) Treated gunny bags only.
(2) Treated gunny bags covered with treated gunny cloth.
(3) Untreated gunny bags covered with treated gunny cloth.
(4) Godowns provided with treated cloth barriers at windows, ventilators and doors.
(5) Spraying of walls with DDT or 666 emulsion.

The author is confident that if due attention is paid to develop the suggested line of action there is no reason why we should not claim eradication of certain pests. However, at present the seed storage and the bulk storage as well appear to become simple and efficient against insect plagues.

V. Conclusions

Pursuing of experiments with DDT or 666 in whitewash appears to be of little advantage. Spraying of emulsions or solutions of DDT or 666 is better substitute for white-washing of godowns where the object is to provide an inimical surface to pests of stored grains.

DDT and 666 act as slow fumigants also; this property helps in dealing away with small infestations present in bags or storage receptacles.

Infestations of stored grain pests can be easily and efficiently eliminated by the use of bags treated with emulsion or solution of DDT or 666. Treated gunny cloth can be employed as cover for stack of bags with equally good results in case the bag treatment is inconvenient to practise.

The scope of the proposed application of DDT and 666 can be intelligently extended over to grains stored in various receptacles in vogue.

Barriers of treated gunny cloth can be put on doors, windows and ventilators of a godown thereby eliminating the use of fine wire-gauze.

Troubles of potato tuber moth are easily remedied by merely covering stored potatoes with a treated gunny cloth.

VI. Acknowledgments

The author acknowledges with gratitude the kind interest taken by Dr. H. S. Pruthi, O.B.E., the then Director of I.A.R.I.; he gladly tenders his thanks to Dr. Taskhir Ahmad, Second Entomologist in-charge of the Division of Entomology, for advice and affording necessary facilities and also to Mr. Manzoor Ahmad for help in carrying out the experiments. Finally, he records his indebtedness to the Imperial Council of Agricultural Research, which financed the scheme for research on insect pests of stored jowar, under which this additional work was carried out in leisure hours.

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1. Mackie, D. B., "Methyl bromide–its expectancy as a fumigant," *Jour. Econ. Ent.*, 1938, **31**, 70–79. 2. Nasir, M. M. "DDT, 666 and Insect Pests of Stored Grains," *Curr. Sci.*, 1946, **4**, 98–99. 3. Nasir, M. M., and Manzoor, A., *Jowar. Its Pests and Storage*, in press. 4. Pruthi, H. S., and Nasir, M. M., "Tests with DDT and 666 as Agricultural Insecticides in India—I. For stored grains,' *Indian Farming*, 1945, **6**, (2), 506–10.

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DIRECTION OF MOVEMENT OF TROPICAL CYCLONIC STORMS

BY S. L. MALURKAR

(*Poona*)

THE movement of a cyclonic storm is of great importance for a forecaster, and to the general public as those who experience the effects of the weather. It is well known that the direction of movement of an extra-tropical cyclone is determined by the cirrus or 6 km. winds in the warm sector or the sector containing the maritime air. Many attempts have been made to find out if similar general rules are likely in the case of tropical disturbances. A systematic attempt was made to study tropical weather and several useful deductions derived.* Taking all salient facts into consideration, it is suggested that a useful rule would be: that *the movement of a tropical cyclonic storm is determined by the higher level air motion corresponding to the sector containing the "energy source" air mass.*

It has been stated that the general sweep of 4, 6 and 8 km. winds gives an approximate direction of motion of the tropical cyclonic storm (p. 46). It has been pointed out (pp. 34-43 and pp. 87-92) that both in the case of monsoon depressions and tropical cyclonic storms, one has to consider the advent of three air masses. Due to various factors and the regions of travel, these air masses cannot be distinguished by the differences of temperature alone. Some characteristics, like the diurnal variation of temperature, content of moisture and degree of inherent instability (latent instability?) have been pointed out as the distinguishing characteristics of the different air masses. The three air masses that go to form the tropical depressions are:

(1) *Equatorial Maritime Air*—which has crossed the equator as a "pulse", from the south to the northern hemisphere and from the north for the southern hemisphere. It has large moisture content and can be made easily unstable and give rise to thunderstorms.

(2) *Transitional Air* (containing mixture of tropical maritime and tropical continental air in varying proportions corresponding to the season and region of the country)—reaching the depression in Indian lattitudes from the far-east, the ultimate origin being the Pacific high.

(3) *Continental Air* (mostly tropical with an occasional slight mixture of Polar continental) reaching Indian area from a north-westerly or westerly direction. The air is dry and is hotter in summer and colder in winter on the surface than the other air masses.

Without the existence of the three air masses, the formation of a monsoon depression or a tropical cyclonic storm is not possible, only a low pressure wave, which travels faster across the country than the depression, results.

In the extra-tropical depressions there are only two air masses involved: one maritime (tropical) and the other continental (tropical or polar in varying proportions depending on the season and locality).

The tropical cyclonic storm recurves towards an easterly direction if it reaches a sufficiently northerly latitude in the northern hemisphere and a southerly latitude in the southern hemisphere. It has been pointed out (p. 100 A and Addendum to p. 47) that it is possible to locate on an extended chart an extra-tropical cyclone or disturbance under whose influence the tropical cyclonic storm apparently recurved.

It is also well known that a tropical cyclonic storm after recurvature and entering the temperate lattitudes has the character of an extra-tropical depression (after Bjerknes). The upper air wind at about 6 km. in the lattitudes nearer the equator (in the regions where the depressions form and in the seasons when they form) are easterly and in the latitudes further away westerly

The tropical cyclonic storm, as a tropical cyclonic storm, fills up soon after the supply of the fresh equatorial maritime air is cut off, due to the formation of a fully formed tropical depression on the other side of the equator. Thereafter the resulting low may be influenced by a passing extra-tropical disturbance and may recurve towards the east.

All the above facts can be integrated into a single unified picture, under the folloing hypotheses:

(1) So long as the movement of the tropical cyclonic storm is some westerly direction, the cyclonic storm has all the three sectors.

(2) When the equatorial maritime air is cut off, the tropical cyclonic storm as envisaged till that time assumes a different character; it may fill up completely or under the influence of an extra-tropical disturbance may recurve towards an easterly direction and hence the recurved cyclonic storm has only two air masses (one maritime and the other continental). This, however, does not prevent its redevelopment into a cyclonic storm with three sectors if a fresh supply of equatorial maritime air reaches the depression, when the depression would once again have a westerly movement.

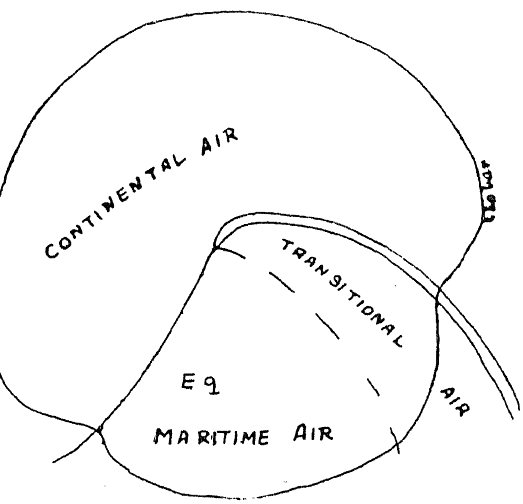
In this connection pp. 116-17 of the book referred to may be seen. The Calicut cyclone is being looked into with collaboration of Mr. P. R. Pisharothy. The cyclone moved eastwards from the S.E. Arabian Sea into the Bay of Bengal, moved in a north-westerly direction and later again recurved in an easterly direction. The speed of motion and the short life pointed to the fact that in the initial and final stages, the depression was influenced by western disturbances. As mentioned there, a secondary of a western disturbance can be destructive and show a good circulation. The several types of cyclonic storms mentioned by Deppermann* and others can also be simplified if they are divided into groups which were secondaries of extra-tropical disturbances and those that formed with all the three

* Draft Notes prepared in Feb.-March 1943 from which extracts were printed as Tech. Notes No. 1. India Met. Dept. and "Forecasting Weather in and near India" Printed limited number in May, 1945 and released in Nov. 1945. To be printed later with diagrams, tables and addenda.

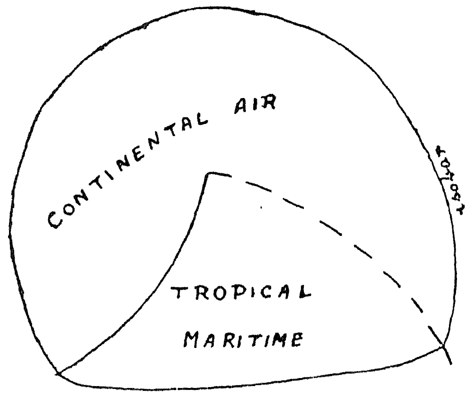
sectors and moved into China Seas. Then the same simplification as made by the author in the book and this note results.

It has been pointed also that the "source" of energy of a tropical cyclonic storm is the equatorial maritime air and the "sink" is the continental dry air or tropical continental air, and that the role of the far-eastern air is to delay the cycle of operations till sufficient vorticity is developed (the earth's rotational effect being smaller in equatorial latitudes, the time required to develop vorticity would necessarily be greater). In the extra-tropical depression the "source" of energy is the tropical maritime air.

In the regions where depressions form near the equator and in the seasons, the easterly and westerly winds at levels from 4 to 8 kms. are well known, and for India were worked out by H. C. Banerjee and K. R. Ramanathan.† The hypothesis and the available diagrams all



1. Tropical Cyclonic Storms (Northern Hemisphere)



2. Recurved Cyclone or Extratropical Depression

show that the direction of movement of the tropical cyclonic storms is determined by the upper air in the equatorial maritime air so long as there are three air masses and by the tropical maritime air when there are only two air masses. To conclude, it follows that the air mass which acts as the energy "source" for the depression seems to control the direction of motion of the depression. The result can be generalised, as a suggestion, that even for a low pressure wave the upper air motion at about 6 kms. in the "source" air mass must determine its direction of motion in addition to all other factors that may be responsible for its movement. When a pulse moves from south of the equator to the north carrying fresh monsoon air often one finds that the surface air is northerly. But the upper air at higher levels give a west south-westerly or even southerly direction, which permits the flow of air under suitable conditions. Further work is in progress.

*Deppermann, "Are there warm sectors in Philippine Typhoons: Bureau of Printing", Manila, 1937.

†*Sc. Notes Ind. Met. Dept.* **13**, p. 21.

APPLICABILITY OF THE PLACZEK'S THEORY OF RAMAN SCATTERING AT HIGH TEMPERATURES

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THE polarisability $\alpha(q)$ of a molecule may be expanded as a series

$$\alpha(q) = \alpha_0 + \sum_j \left(\frac{\partial \alpha}{\partial q_j}\right)_0 q_j + \frac{1}{2}\sum_j \left(\frac{\partial^2 \alpha}{\partial q_j \, \partial q_k}\right)_0 q_j q_k + \ldots, \qquad (1)$$

where the suffix 0 refers to the equilibrium configuration. q_j, q_k, etc., are the various normal co-ordinates of the moleculs and a particular set of values of q_j, q_k, etc., define a configuration q of the molecule.

The first term α_0 which is independent of the nuclear vibrations is responsible for Rayleigh scattering, while the term in $\left(\frac{\partial \alpha}{\partial q_j}\right)_0$ gives rise to Raman effect. The aggregate intensities of the Stokes and the anti-Stokes Raman lines according to the Placzek's theory of Raman scattering are given by (2) and (3) respectively.

$$I_{(\nu-\nu_j)} = \frac{64\pi^4}{3c^3}(\nu-\nu_j)^4\{4A^2_{1j}-7B_{1j}\}\frac{1}{1-e^{-\frac{h\nu_j}{KT}}} \qquad (2)$$

$$I_{(\nu+\nu_j)} = \frac{64\pi^4}{3c^3}(\nu+\nu_j)^4\{4A^2_{1j}-7B_{1j}\}\frac{1}{e^{\frac{h\nu_j}{KT}}-1} \qquad (3)$$

where A_{1j} and B_{1j} are the invariants of the symmetric tensor $\left(\frac{\partial \alpha}{\partial q_j}\right)_0$. The ratio of the intensity of the Stokes Raman line to that of

the corresponding anti-Stokes line is given by (4).

$$\frac{I_{(\nu-\nu_j)}}{I_{(\nu+\nu_j)}} = \left(\frac{\nu-\nu_j}{\nu+\nu_j}\right)^4 e^{\frac{h\nu_j}{KT}} \qquad (4)$$

The following are the main features of the Placzek's theory of Raman scattering.

(1) The intensity of the Stokes lines increases with the increase of temperature.

(2) The intensity of the anti-Stokes lines increases more rapidly than the Stokes lines with the rise of temperature.

(3) The intensities of the Stokes and the anti-Stokes lines become very large at high temperatures and tend to meet each other at infinite intensity.

(4) The ratio of the intensities of the Stokes and the anti-Stokes lines is given by the relation $\left(\frac{\nu-\nu_j}{\nu+\nu_j}\right)^4 e^{\frac{h\nu_j}{KT}}$.

From the investigation carried out by the author, both in solids and liquids, the following observations can be made:—

(1) The intensity of the Stokes lines decreases with the rise of temperature, the decrease in the case of calcite is more rapid for the low frequency lines.

(2) The intensity of the anti-Stokes lines, in general, increases with the increase of temperature, except in calcite, but not to the extent as is expected by the Placzek's theory.

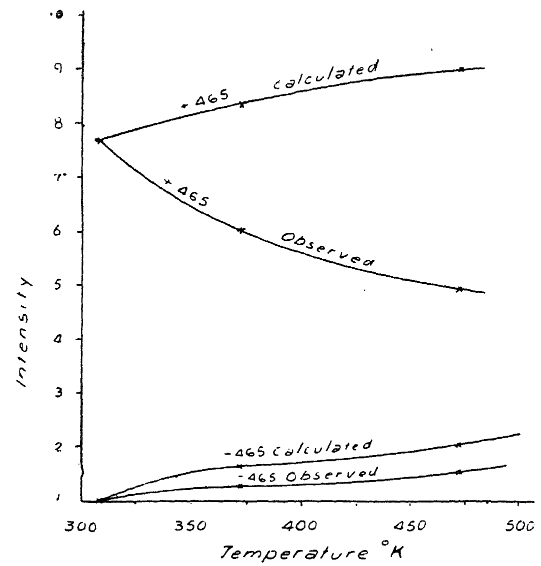
(3) The intensities of the Stokes and the anti-Stokes lines tend to meet each other at some finite value with increasing temperature.

(4) The ratio of intensities of the Stokes and the anti-Stokes lines, at all temperatures, is in agreement with the result expected from the Placzek's theory. The ratio approaches more and more towards unity with the increase of temperature.

The observed and calculated intensities of the Stokes and anti-Stokes lines at 465 cm.$^{-1}$ in quartz, at different temperatures, are shown in Fig. 1.

One obvious criticism of the Placzek's theory is that he has taken only the first term $\left(\frac{\partial \alpha}{\partial q_i}\right)_0$ and not the higher order terms to determine the intensities of the fundamental Raman lines. The author has tried the next higher order term but has obtained the contribution of it as very small. Hence the observed result, namely, the decrease in intensity of the Stokes lines with increase of temperature, cannot be explained by taking the higher order terms also into consideration.

It can be seen from expression (2) that the inference that the Stokes lines increase in intensity with the increase of temperature is due to the exponential factor, namely, $\frac{1}{1-e^{-\frac{h\nu_j}{KT}}}$ taking the other factor as constant at all temperatures. We can take the term $\frac{64\pi^4}{3c^3}(\nu-\nu_j)^4$ as constant. The other term $(4A^2_{1j} - 7B_{Aj})$ comes out from $\left(\frac{\partial \alpha}{\partial q_j}\right)_0$ and if we take that as constant it means we are taking $\left(\frac{\partial \alpha}{\partial q_j}\right)_0$ as constant at various temperatures. The Taylor's expansion is valid only in the close vicinity of the equilibrium configuration. But as the temperature is increased the amplitudes become larger and larger and we can no longer take the Taylor's expansion, which is taken in the close neighbourhood of the equilibrium configuration, as valid. Therefore $\left(\frac{\partial \alpha}{\partial q_j}\right)_0$ cannot be taken as constant. It will decrease rapidly with the increase of the temperature. In Placzek's theory it was customarily taken as constant.



In the case of the Stokes lines, the increase due to the exponential factor is not very large but as the decrease due to the diminution in $\left(\frac{\partial \alpha}{\partial q_j}\right)_0$ with the increase of temperature is considerable, the net result will be a decrease in the intensity. For anti-Stokes lines, the increase due to the exponential factor is very large but due to the other factor it is pulled down to a certain extent, the result being an increase but not to the expected extent. In the case of calcite, the decrease in intensity of the Stokes lattice lines is very large which shows that the diminution of $\left(\frac{\partial \alpha}{\partial q_i}\right)_0$ with rise of temperature is correspondingly very large. Hence it becomes predominant in the case of the anti-Stokes lines, the result being a decrease in the intensity of the anti-Stokes lines also. The ratio of intensities of the Stokes and the anti-Stokes lines is, however, unaffected by this variation in $\left(\frac{\partial \alpha}{\partial q_i}\right)_0$ with temperature.

The author is thankful to Prof. S. Bhagavantam for the interest he has taken in this work.

LETTERS TO THE EDITOR

A GENERALISATION OF LAPLACE'S TRANSFORM

1. Transforms of the type

$$\phi (p) = p \int_0^\infty F (xp)\, f (x)\, dx$$

have long been known and the special case of this when $F (xp) \equiv e^{-xp}$ and hence

$$\phi (p) = p \int_0^\infty e^{-xp} f (x)\, dx \tag{1}$$

has led to the subject of Operational Calculus, a powerful tool for tackling problems in Mathematical Physics and on which exists a good deal of literature. The relation (1) is known as Laplace's integral. It is possible to generalise[1] Laplacian Transform and the object of this note is to give an interesting generalisation and to introduce a new calculus based on this generalised Laplace's Transform.

2. If we take

$$F (xp) \equiv (2\, xp)^{-\frac{1}{4}}\, W_{k,m} (2\, xp)$$

where[2] $W_{k,m} (x)$ denotes a Whittaker Function, we obtain the transform

$$\phi_m{}^k (p) = p \int_0^\infty (2\, xp)^{-\frac{1}{4}}\, W_{k,m} (2\, xp)\, f (x)\, dx \tag{2}$$

For $k = \frac{1}{4}$ and $m = \pm \frac{1}{4}$ when $(2xp)^{-\frac{1}{4}} W_{k,m} (2xp)$ degenerates into e^{-xp} we get Laplace's Transform.

We shall call $\phi_m{}^k (p)$ as the Whittaker or $W_{k,m}$-transform of $f (x)$ and $f (x)$ the original of $\phi_m{}^k (p)$ in this new transform.

In view of the involved nature of the function $(2xp)^{-\frac{1}{4}} W_{k,m} (2xp)$ as compared to the exponential function e^{-xp}, theorems based on this generalised Laplace's transform are not so easy to prove. We give, for the present, without proof, five theorems for this new Calculus.

Theorem 1A. If $\phi^k{}_m (p)$ is the Whittaker Transform of $f (x)$, then $\left(-p \frac{d}{dp}\right)^n \phi^k{}_m (p)$ is the Whittaker Transform of $\left(x \frac{d}{dx}\right)^n f(x)$.

Theorem 2A. If $\phi_m{}^k (p)$ and $\psi^{k'}{}_{m'} (p)$ are the $W_{k,m}$-and $W_{k',m'}$-transforms of $f (x)$ and $\psi (x)$ respectively, then

$$\int_0^\infty \phi^k{}_m (x)\, \psi (x) \frac{dx}{x} = \int_0^\infty \psi^{k'}{}_{m'} (x)\, f (x) \frac{dx}{x}.$$

This theorem may be considered as a Parseval Theorem in the Theory of Whittaker Transforms.

Theorem 1B. If $\phi^k{}_m (p)$ is the Whittaker transform of $f (x)$, then

$$\int_0^\infty \phi^k{}_m (x) \frac{dx}{x} = \frac{\Gamma (\frac{5}{4} - m)\, \Gamma (\frac{5}{4} + m)}{2\, \Gamma (\frac{7}{4} - k)}$$

$$2F_1\left[\begin{matrix}\frac{5}{4}+m, \frac{5}{4}-m \\ \frac{7}{4}-k\end{matrix}; \frac{1}{2}\right] \int_0^\infty \frac{f(x)}{x}\,dx.$$

Theorem 2B. If $\phi^k{}_m(p)$ is the Whittaker Transform of $f(x)$, and $\bar{f}(p)$ is the Laplace Transform of $\psi(x)$, then

$$\phi^k{}_m(p) = \frac{\Gamma(\frac{9}{4}+m)\,\Gamma(\frac{9}{4}-m)}{4p\,\Gamma(\frac{11}{4}-m)} \times$$

$$\int_0^\infty 2F_1\left[\begin{matrix}\frac{9}{4}+m, \frac{9}{4}-m \\ \frac{11}{4}-m\end{matrix}; -\frac{s-p}{2p}\right] \psi(s)\,ds.$$

Theorem 1 C. If $\phi^k{}_m(p)$ is the Whittaker Transform of $f(x)$, then

$$\sum_{r=0}^{\infty} \frac{1}{r!}\left(\frac{1}{\alpha}-1\right)^r \phi_m{}^{k+r}(p)$$

$$= p\,\alpha^k \int_0^\infty (2xp)^{-\frac{1}{2}} e^{xp(1-\alpha)}\, W_{k,m}(2xp\alpha)\, f(x)\,dx.$$

3. Theorems marked A are exactly similar in form to the corresponding ones in the theory of Operational Calculus, those marked B have generalised appearances and give, as particular cases, the corresponding theorems of Operational Calculus, due to Van der Pol[3] and Humbert.[4] It is interesting to note that the Theorem 1 C has no analogue in the Ordinary Operational Calculus.

4. Special cases, besides the ordinary Laplace's Transform, of the general transform (2) may be obtained by taking particular cases of Whittaker functions. The following may be noted :

(i) K_n — transform [$K_n(x)$ denoting Bessel Functions of the second kind for imaginary arguments]

$$\phi_m{}^0(p) = (p/\sqrt{\pi}) \int_0^\infty (2xp)^{\frac{1}{2}} K_m(xp)\, f(x)\,dx.$$

This is obtained by taking $k = 0$ in (2).

(ii) $L^n{}_s$—transform [$L_s{}^n(x)$ denoting generalised Laguerre Polynomials].

$$\phi^{\frac{1}{2}+\frac{1}{2}n+s}_{\pm\frac{1}{2}n}(p) = (-)^s\, s!\, p \times$$

$$\int_0^\infty \left\{(2xp)^{\frac{1}{2}n+\frac{1}{2}} e^{-xp} L^n{}_s(2xp)\right\} f(x)\,dx.$$

This is obtained by taking $k = \frac{1}{2} + \frac{1}{2}n + s$ and $m = \pm\frac{1}{2}n$ in (2).

(iii) D_n — transform [$D_n(x)$ denoting Weber's parabolic cylinder functions]

$$\phi^{\frac{1}{2}n+\frac{1}{4}}_{\pm\frac{1}{4}}(p) = 2^{-\frac{1}{2}n}\, p \times$$

$$\int_0^\infty D_n(2\sqrt{xp})\, f(x)\,dx.$$

This is obtained by taking $k = \frac{1}{2}n + \frac{1}{4}$ and $m = \pm\frac{1}{4}$ in (2).

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April 6, 1946.

1. See Widder, *The Laplace Transform* (Princeton University, 1943, and Meijer, *Proc. Kon. Akad. v. Wetensch, Amsterdam*, 1941, **44**, 727-37. 2. Whittaker and Watson, *Modern Analysis*, (fourth edition, 1935), 337-54. 3. Van der Pol, *Phil. Mag.*, 1929, **8**, 864-5. 4. Humbert, *Bulletin de la Soc. Mathematique*, 1937, **65**, 3.

A MODIFIED DEFINITION OF PROBABILITY

The author of a recent paper[1] on the definition of probability points out that the Von Meyses' definition of probability, namely, that probability p is the limit of the sequence s/n as n tends to infinity, where s is the number of successes in n trials, imposes a restriction on the number of successes in m trials succeeding a certain number of n trials. If μ denotes the number of successes in m trials, namely, from $n+1$th to the $n+m$th, μ should lie between

$$(p-\epsilon)\,m - 2\,\epsilon n_0 \text{ and } (p+\epsilon)\,m + 2\,\epsilon n_0$$

for every $n > n_0$. This has been derived from the fact that $s/n \to p$ and $\frac{s+\mu}{n+m} \to p$. It is argued that since ϵ is a small quantity, the above restriction implies that μ should lie between the narrow limits $(p-\epsilon)m$ and $(p+\epsilon)m$; whereas μ can take any value from 0 to m.

It is surprising that the author has gone so far to get this restriction, which is obvious on the face of the definition itself. For mp denotes the expected number of successes in m trials, and when m is sufficiently large μ should lie between $m(p-\epsilon)$ and $m(p+\epsilon)$; this is true because p is the limit of μ/m as m tends to infinity. It is not advisable to consider the m trials made after the nth trial separately. Either they can be considered as two separate experiments or may be considered as one experiment of $n+m$ trials. Further when p is defined as the limit of s/n as n tends to infinity, it naturally means that s should lie between $n(p-\epsilon)$ and $n(p+\epsilon)$. It is only this principle that is revealed even in the case of the m trials succeeding the first n trials; and shows that μ should lie between $m(p-\epsilon)$ and $m(p+\epsilon)$ when m is large. There is nothing wrong in this. The fact that the number of successes μ may be anywhere from 0 to m in m trials, is equally true in the case of the first n trials and s can take any value from 0 to n. This can never be the case. In fact the statistical definition of probability shows that s will not take any random value from 0 to n but will lie between $n(p-\epsilon)$ and $n(p+\epsilon)$; or even μ will lie between $m(p-\epsilon)$ and $m(p+\epsilon)$ when m is large. Whether it is the first n trials or last m trials, the same principle holds; the quasi-limit definition introduced in the above paper is only an unwanted burden on a pure, simple yet precise definition. On the other hand if it is conceded that μ can vary from 0 to m (*i.e.*, s can take any value from 0 to n) and recognise the possible randomness of the number of successes, we can immediately close all our books on actuarial science, stat-

istical distributions including statistical mechanics and enjoy peaceful rest.

Mysore, V. S. ANANTHACHAR.
September 21, 1946.

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1. *Theories of Probability*, by Jagit Singh, p. 257. *Sankhya*, April 1946, 7, Part 3.

A NOTE ON THREE NUMBERS IN A.P.

1. IN what follows A-G.P. stands for Arithmetico-Geometrical Progression, and I.R. for Indicator of Ratio of A-G.P., which means the common ratio of the component geometric series of A-G.P.

2. *Lemma.*—If a, b, c are in A.P., then a, $\frac{ab}{c}$, $\frac{a^2}{c}$ are also in A.P.

c, b, a are in A.P. (given).

Multiply each by the same number $\frac{a}{c}$ the result follows at once.

3. *Theorem.*—Any three numbers in A.P. are also A-G.P. having I.R. equal to the quotient obtained by dividing the third number by the first, provided neither the first nor the third number is zero.

Let the given numbers in A.P. be a, b, c, where $a \neq 0$ and $c \neq 0$.

These numbers can be written as

$$a, \frac{ab}{c}\left(\frac{c}{a}\right), \frac{a^2}{c}\left(\frac{c}{a}\right)^2, \quad (1)$$

which can be obtained by multiplying the corresponding terms of the following sets:

$$1, \frac{c}{a}, \left(\frac{c}{a}\right)^2, \quad (2)$$

$$a, \frac{ab}{c}, \frac{a^2}{c}. \quad (3)$$

Clearly (2) is a G.P., (3) is an A.P. (Lemma).

$\therefore$ (1) is an A-G.P. having $\frac{c}{a}$ as I.R.

Hence the theorem.

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December 7, 1946.

FURTHER CONSEQUENCES OF THE "ACTIVATED LAYER" POSTULATE IN THE MECHANISM OF THE *LIGHT-EFFECT*

§1. THAT the *light-effect* Δi, a reversible and (sensibly) instantaneous current-change, on irradiation from extreme red[11] to X-rays,[11a] of chlorine and a number of other gases and vapours, is (so far) observed with semi- and full ozoniser discharges,[1,2] suggests that a dielectric surface is necessary for its occurrence. The ozonizer (Fig. 1*a*) is equivalent to a compound condenser, consisting of three serial capacities: C_1 and C_2 are associated with the inner and outer electrode walls respectively; the annular space filled with the gas represents the third, C_g. As illustrated by the generally low dielectric constants of gases, C_g is the smallest capacity; and is therefore, a chief determinant of i at a given potential V applied to the system.[4] The combined capacity

Fig. 1(a)

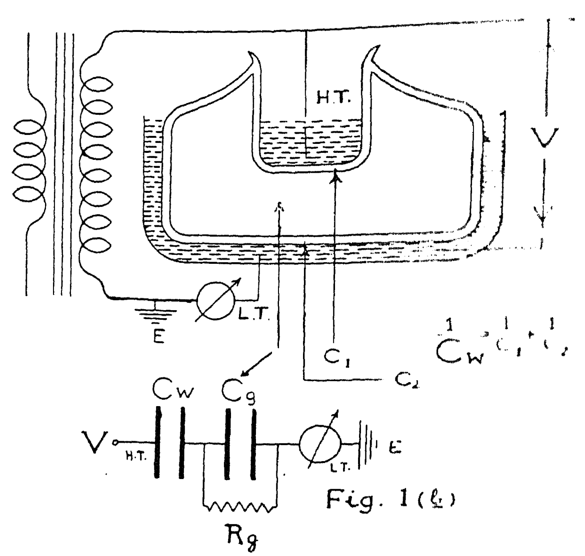

Fig. 1(b)

due to the inner and outer annular walls may be denoted by C_w, defined by $\frac{1}{C_w} = \frac{1}{C_1} + \frac{1}{C_2}$. At the *'threshold potential'* V_m,[3,4] the gas breaks down as a dielectric; the corresponding C_g may, therefore, be treated as a condenser shunted by an ohmic resistance, R_g; this represents the inverse of conductivity produced in the gas due to ionisation by collision under field due to V.

§2. The instantaneous i in the circuit may be denoted to a good approximation by,

$$i = \frac{V}{jL\Sigma f + \frac{1}{jC_w\Sigma f} + \frac{1}{\frac{1}{R_g} + jC_g\Sigma f}} \quad (i)$$

where Σf represents not only the frequency of the A.C. supply and its harmonics but also those produced under electrical discharge in the annular space due[6,7,8,2] to V. The *light-effect* Δi is observed at constant V; the corresponding circuital inductance L does not change sensibly. It follows, therefore, from (i) that the production of, *e.g.*, photo-diminution Δi implies an increase of R_g; that is, decrease of the ohmic or the conduction current; or/and. decrease of either or both the capacities C_w and C_g, due to the annular walls and the excited gas, respectively.[9] In a semi-ozoniser, the capacity C_1 is absent; it produces, however, a comparatively large $-\Delta i$ (as also $+\Delta i$ under appropriate conditions *vide infra* para 4). That a preponderatingly large photo-change, *e.g.*, increase of R_g might mask a possible variation of either or both C_w and C_g in a sense opposite to that contemplated in the

above deduction, *viz.*, a decrease, requires further investigation.

Below V_m there is no ionisation current in the gas,[3,4] *i.e.*, R_g is infinite. The non-occurrence of the *light-effect* below[2,6,7,10] V_m despite intense irradiation in the ultra-violet[11] and even X-rays,[11a] suggests from (*i*) that the above capacities are not altered sensibly by a mere optical excitation of the gas. The term $\left(\frac{1}{R_g} + jC_g\Sigma f\right)$ is small at low V; and sensitive to change with a corresponding marked effect on $-\Delta i$. It follows, therefore, that relatively, $-\%\Delta i$ should be low (numerically) at large V, subject to the assumption that C_w is not affected sensibly; this deduction is in accord with the generality of the results in these Laboratories which show that $-\%\Delta i$ is a maximum near V_m and decreases thereafter.[1,2,11]

§3. A possible mechanism was developed previously for the decrease by light of $1/R_g$ the ionisation current, from a consideration of the corresponding behaviour of the (electrically) *excited* gas;[1,2,11,12] this has considerable electron affinity, *e.g.*, about 4·8 volts for normal Cl, and greater if *excited*.[11,2] An assumption was then made that a photo-electric emission from an activated electrode layer(s) in dynamical equilibrium with the gas phase is a primary reaction;[11,13] the conversion of these photo-electrons into slow moving negative ions due to the electron affinity of the excited medium should reduce *i*, as in the space charge effect.[12,13] That the numerical decrease of $-\%\Delta i$ in various gases is as $Cl_2 > Br_2 > I_2$, $HCl > O_2$ Air $> H_2 > N_2$, Ne; and the increase in the normally low $-\Delta i$ in air due to traces of impurities as $Cl_2 > Br_2 > I_2$, which is also the order for their electron affinity, receives a simple explanation. Franck and co-workers, especially Compton, have argued that '*excitation*' of even metallic and rare gas atoms increases appreciably their electron affinity. Anticipated from these considerations, appreciable $-\Delta i$ has actually been observed by the author in vapours of alkali metals (*e.g.*, over 30% in potassium vapour, near V_m; and by Prasad in these Laboratories in mercury vapour; $-\%\Delta i$ has been more than suspected in other similar systems which previously failed to show it due to limitations of the available detector. Being formed on a dielectric surface, this layer might contain ions of both signs (*vide infra* para 4); their electrostatic and inductive influence on the ions and molecules in the gas phase, modifies the annular capacity C_g distinctive of the normal gas.[12,13] A photo-electric emission from this electrode layer entails a capacitative change[12,13,9] in C_g (and, therefore, a phase-shift)[9,13,4] leading to the *light-effect* $-\Delta i$ from (i). This postulate of an electrode layer[12,13,4] is found useful in interpreting results for the '*zero order*' discharge reactions[14] and of a new type of a wide-spread '*periodic effect*'[1,4,14,15] under certain conditions of electrical discharge. (*a*) Prolonged 'aging' under the discharge; or/and surface 'impurities' should affect the 'work function' determining the behaviour of the electrode-layer;[12,13,4] and, therefore, magnitude of the corresponding '*periodic effect*'[1,4,14,15] and especially $-\Delta i$.[31] (*b*) Also on this view, the relative $-\Delta i$ should increase (numerically) by increasing *ceteris paribus* the surface area in the excited system. (*c*) On the other hand, use of high potentials and especially heating would cause irreversible desorption and depolarisation of the ions and other particles constituting the semi-gas, electrode layer; these would instabilise it, and therefore, reduce the corresponding $-\Delta i$ and also the '*periodic effect*'.[1,4,11,15] These predictions *a,b,c* are fully borne out by experimental results. In $-\Delta i$ the minimum time-lag[6,7,2,13] is remarkably small, of the order of a micro-second or even less. It is not unlike the 'relaxation time', as suggested particularly by the production of an appreciable $-\Delta i$ *under H.F. discharge*. This indicates that compared with the '*periodic effect*',[1,4,11,15] $-\Delta i$ originates from a more elementary and reversible light-action such as, *e.g.*, an ionic exchange or/and orientation between the electrode layer and space charge in the excited gas.

§4. It is significant for the general mechanism of the *light-effect* phenomenon that $-\Delta i$ is much wider occurrent than the positive effect, $+\Delta i$. The latter, however, is to be anticipated from the greater probability of photo-ionisation of pre-excited particles.[11a,5] Large $+\Delta i$ has been observed[1,9] in numerous cases under insufficiently understood conditions such as, special coating materials on the angular walls, *e.g.*, *with* KI_3 + KI mixture, vapours of iodine, phosphorus and sulphur. An abnormal working of a metal oxide type detector; spontaneously, after long 'aging' at a constant V in a semi-ozoniser excitation, etc.; a *low* applied V would appear to favour $+\Delta i$ under these conditions. A *positive* effect is also observed especially under heavy inputs to a triode, tetrode and pentode. The photo-electric action is assumed to be fundamental to the general *light-effect* mechanism (*vide* §3).[12,13] From equation (i), $+\Delta i$ implies (subject to the assumptions discussed in §2) an *increase* of the conduction current $1/R_g$, or/and of the capacities C_w and C_g. The electrode-layer mechanism suggests that $+\Delta i$ may be attributed to an emission of the positive ions under light, which comparatively is less frequent than the electronic emission. The author's finding *that the high frequency region of i is the chief seat of the light effect*[8,6,9] has now been substantiated by numerous results over a wide range of conditions of excitation and detection. It is of considerable interest, therefore, to record here the observation of over 40 per cent. *positive* effect reproducible *ad libitum* in chlorine with but ordinary light, *under H.F. excitation near* V_m; and *also at low frequency excitation*, when the relative surface is multiplied by introducing powdered wall material in the annular space; this was suggested by the marked significance to the *light-effect* phenomenon of the solid-gas interface and its immediate neighbourhood in the gas phase.[1,9,5,16] With both these modes of excitation (up to a limit, §2), a larger V reveals the more familiar $-\Delta i$ as large as 40 to 70 per cent. current decrease; the transition $+\Delta i \rightleftharpoons -\Delta i$ is potential reversible; near the

special case $\Delta i = 0$, the system shows especially under H.F. excitation, a characteristic instability.

Department of Chemistry,
Benares Hindu University,
November 13, 1946.
S. S. Joshi.

1. Joshi, *Presi Addr., Chem. Sec., Indian Sci. Cong.*, 1943. 2. —, *Proc. Indian Acad. Sci.*, 1945, **A22**, 389–93. 3. —, *Curr. Sci.*, 1939, **8**, 584. 4. —, *ibid.*, 1946, **15**, 281. 5. —, *ibid.*, 1945, **14**, 35. 6. —, *ibid.*, **1944**, **13**, 253. 7. —, *Nature*, 1944, **154**, 147. 8. —, *Curr. Sci.*, 1945, **14**, 67. 9. —, *Proc. Indian Acad. Sci.*, 1945. **A22**, 225. 10. Joshi and Lad, *ibid.*, 1945 **A22**, 293. 11. —, *Curr. Sci.*, 1945, **14**, 317; 11*a*. —, *ibid.*, 1944, **13**, 278. 12. —, *Proc. Indian Sci. Cong.*, *Phys. Sec.*, Abst 26 (1946). 13. —, *ibid.* (communicated). **14**. —, *Curr. Sci.*, 1946 **14**, **175**. 15. Joshi and Deshmukh, *Nature*, 1945, **155**, 483. 16. Deo, *Proc. Indian Acad Sci.*, 1945, **A21**, 76–80. 17 Prasad, *Nature*, 1945 **155**, 362. 18. Tiwari and Prasad, *Curr. Sci.*, 1945, **14**, 229. 19. Das-Gupta, *Sci. and Cult*, 1945, **11**, 318. 20. Sahay, *Curr. Sci.*, 1945 **14**, 122. 21. Deb and Ghosh, *Sci. and Cult.*, 1946, **12**, 17.

ASYMMETRY OF SHAPE AND PERIODS OF OSCILLATION IN ELECTRIC FIELDS

Krishnan, Guha and Banerjee* showed that the period of oscillation of an isotropic body suspended in a uniform magnetic field is not appreciably affected even when there is a considerable asymmetry of shape. Different results are to be expected in an electric field. In accordance with such an expectation, the following interesting observations have been made by the author.

The period of oscillation of a rectangular glass plate, with sides in the ratio 1:2 and suspended by a silk fibre about an axis perpendicular to the plate in a uniform electric field, is determined at various field strengths. A definite relationship between the period and the field strength is found to exist.

The period, provided the torsion of the fibre is nil, may be expected to be inversely proportional to the voltage employed for obtaining the field between two parallel plates. If there is a finite torsion of the suspending fibre, which is the case in the experiment conducted, the period may be corrected for the torsion by forming a quantity T′ equal to $T\sqrt{\frac{T_0^2}{T_0^2 - T^2}}$ where T and T_0 are respectively the periods in the field and out of the field. T′ is found to vary inversely with voltage. Graphs between $\frac{1}{T'}$ and the voltage, obtained in several typical experiments with rectangular bits of glass, are found to be straight lines. It is also observed that T′ is the same whether the voltage applied is a direct or an alternating one.

The results are now published with a view to draw attention to the fact that this dependence of T′ on voltage applied between two fixed parallel plates offers a simple method of measuring voltages. Though it takes some time for making such measurements, this method has the advantage of using very simple apparatus available in any laboratory.

While seeking for the origin of the turning moment on suspended bodies which have only a shape asymmetry but no dielectric anisotropy, it has been found that $\frac{I}{T'^2V^2}$ is the same for rectangular pieces of glass, ebonite and lead, provided the shape and dimensions are kept constant. I is the moment of inertia of the body about the axis of suspension, and V is the applied voltage. From this observation, it is to be concluded that the turning moment is due to an asymmetric distribution of the accumulated charge on the surface of the suspended body and not due to the asymmetry of the field within the body or to the dielectric nature of the body.

In the magnetic case, where there are no surface effects and where the difference in the internal fields arising out of demagnetisation is very small, effects analogous to the above cannot be expected.

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December 16, 1946.
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* *Phil. Trans.*, A, 1933, **231** 235.

MOLECULAR STRUCTURE OF CH_3CN

If the C—C≡N chain in CH_3CN is linear, that is, if the molecule is axially symmetric having a three-fold axis of symmetry, it should give rise to four totally symmetric and four doubly degenerate vibrations. All of them would be Raman-active. If the chain is not linear, each degenerate vibration splits up into two so that we should expect twelve fundamentals which are Raman-active.

The Raman spectrum of CH_3CN has been studied by a few authors. Ten Raman lines have been recorded. The number of the observed Raman lines alone will not help us to fix up the structure of CH_3CN molecule. The polarisation data are essential to decide the structure but they are not available.[1]

The author has undertaken the polarisation measurements of the Raman lines in CH_3CN. The usual condenser method of illumination has been used and a properly oriented Wollaston double-image prism placed in the path of the scattered beam enabled us to photograph the horizontal and the vertical components simultaneously. The polarisation measurements of six Raman lines have been made. The remaining four lines are extremely weak and their polarisation characters could not be studied. Four lines at 920, 1375, 2250 and 2940 cm.$^{-1}$ have been found to be well polarised. They can be taken as the four total symmetric lines. Two lines at 380 and 3000 cm.$^{-1}$ are depolarised. The observed polarisation characters of the Raman lines in CH_3CN are strongly in favour of the symmetrical model.

Details will be published elsewhere.

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Andhra University,
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December 9, 1946.
K. Venkateswarlu.

1. Herzberg, *Infra-Red and Raman Spectra of Polyatomic Molecules*, p. 332.

BORIC ACID *AND THE O-HYDROXY-CARBONYL COMPOUNDS*; MELTING POINT *CURVES*

It is well-known that boric acid exerts remarkable effects on the optical rotation and electrical conductivity of aqueous solutions of polyhydric alcohols, phenols and hydroxy acids such as malic, tartaric and salicylic acids. As an explanation, compound formation has been assumed by van't Hoff, Boeseken and others but complete and satisfactory evidence for this view has been lacking, the chief difficulty being isolation of compounds which undergo hydrolysis very readily. Bancroft and Davis[1] explain the well-known increase in acidity, of an aqueous solution of boric acid on the addition of glycerine, as due to an increase in the ionisation, the ionising power of aqueous glycerine being greater than that of water. For a critical account of the large amount of literature on the subject, the paper by these authors may be referred to.

Of the large number and wide variety of *o*-hydroxy-carbonyl compounds available, only salicylic acid has received attention so far in this connection. There is evidence to show that boric acid reacts with *o*-hydroxy carbonyl compounds in the presence of a dehydrating agent, producing complex chelate structures which exhibit prominent colour changes or fluorescence. Mention may be made of the work of Dimroth,[2] Feigl,[3] Neelakantam[4] and others. The present authors have, therefore, undertaken systematic investigation of compound formation with them.

As the first part of the investigation, the melting point curves of boric acid in the presence of some o-hydroxy-carbonyl compounds, which were synthesised for this purpose, have been constructed. The determination of the melting point of boric acid itself is complicated by the fact that it readily undergoes dehydration. Apparently this is responsible for some contradictions in literature regarding its stability and melting point. Philbrick and Holmyard[5] state that at 100° C. or a little over, boric acid forms the meta-acid, at 140° C. the pyro-acid and the anhydride is obtained only by strong heating. Hackspill and Kieffer,[6] on the other hand, state that the ortho-acid is stable only up to 90° C., at 100° C., the decomposition is explosive and 95 per cent. of the water is lost forming boric anhydride with a little water of adsorption and at 250° C. all the water is lost. Stackelberg, *et al.*[7] report 170° C. for the ortho-acid. Mehta and Kantak[8] recently calculated the melting point of the ortho-acid from the data obtained by them for melting points of mixures with glucose, galactose and tartaric acid. Their values are 169·5, 170·5 and 160·9° C. respectively. The considerably low value obtained in the last case is ascribed to compound formation. By melting the boric acid in a corked test-tube and determining the m.p. of the powdered melt we obtained 177° C.

Mixtures of boric acid and the organic compound in known proportions were prepared by weighing the two components in ignition tubes, sealing off the tubes and heating the tubes gradually in a sulphuric acid or glycerol bath. In all cases excepting 2-acetyl-1 naphthol, there was an initial lowering of the melting point of boric acid. The melts were quickly powdered and the melting points taken.

In the following table, the maxima temperatures and molecular ratios corresponding to them read out from the graphs constructed are shown.

Surprisingly enough the last compound caused an initial rise in the melting point of boric acid instead of the usual lowering on addition of the substance. Evidence for compound formation is indicated in the curves. The molecular ratios, however, indicate that the matter is more complicated. Further investigation is in progress.

Table I

Serial No.	Compound	M.P. °C.	Maxima °C.	Molecular ratios: Boric acid	Molecular ratios: Compound
1	Resacetophenone	143	196	4	1
2	Gallacetophenone	171	195	4	1
			182	2	3
3	Resorcylic aldehyde	135	199	3	1
4	2-Acetyl-1-naphthol	102	220	3	1

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December 21, 1946.

1. Bancroft and Davis, *J. Phys. Chem.* 1930, **34**, 2479. 2. Dimroth, *et al.*, *Berichte*, 1921, **54B**, 3020; *Annalen*, 1925, **446**, 97. 3. Feigl and Krumholz, *Mikrochemiei Pregl-Festschrift*, 1929, **77**. 4. Neelakantam, *et al.*, *Proc. Ind. Acad. Sc.*, 1943, **18A**, 364. 5. Philbrick and Holmyard, *A Text-book of Inorganic and Theoretical Chemistry*, 1941, p. 481. 6. Hackspill and Kieffer., *Chem. Abs.* 1931, **25**, 258. 7. Stackelberg *et al. Zeit. Electrochemie*, 1937, **43**, 14. 8. Mehta and Kantak, *Current Science*, 1946, **15**, 129.

ELECTROLYTIC HYDROGENATION OF CRESOLS

BANCROFT and George[1] have shown that the hydrogenation of phenol at a platinised-platinum cathode is not an electrolytic process and is probably the result of oriented adsorption of the phenol molecule, the platinised-platinum acting as a source of hydrogen. It was thought that a study of the hydrogenation of the three isomeric cresols under the same conditions would throw greater light on the mechanism of hydrogenation at the cathode, besides revealing the influence of substitution on the process of hydrogenation. The results obtained in the course of the study not only supports the view of the authors referred to above but also shows that the extent of hydrogenation is different in the case of each cresol as could be seen from the results given below:

o-*Cresol*	m-*Cresol*	p-*Cresol*
33·5%	41%	24·3%

(1/20 gm. mol. of each cresol was hydrogenated in a porous pot in 22 per cent. sulphuric acid with vigorous stirring, the C.D. being 4 amps./dm.^{2} The theoretical quantity of current, 6 F./mol. was passed in each case.)

The maximum yield of hydrogenated product is obtained with *m*-cresol. The variation is due evidently to the influence of the position of the methyl group on the oriented adsorption of the cresol molecule on the electrode surface.

The hydrogenated product was found to be a mixture of methyl cyclohexanol and the corresponding methyl cyclohexanone. Analysis by Bennett and Donovan's hydroxylamine method[2] showed the product in each case to contain the proportions of ketone indicated below:

	o-*Cresol*	m-*Cresol*	p-*Cresol*
Ketone %	32·8	50·0	36

An entirely different effect was noticed when a cathode consisting of a mixed deposit of platinum and palladium in equal proportions was employed. The results are summarised below:

	o-*Cresol*	m-*Cresol*	p-*Cresol*
Total yield of hydrogenated product	25%	32·9%	43%
Ketone%	55%	80·1%	62·7%

Vavon and Berton[3] have reported the formation of ketones during the hydrogenation of cresols in the liquid phase using platinum black catalyst. The hydrogenation at the platinised-platinum cathode is exactly similar. It is, therefore, to be concluded that the hydrogenation is purely catalytic, and not electrochemical.

Department of Chemistry, M. V. SITARAMAN.
Presidency College, V. V. RAMAN.
Madras,
December 18, 1946.

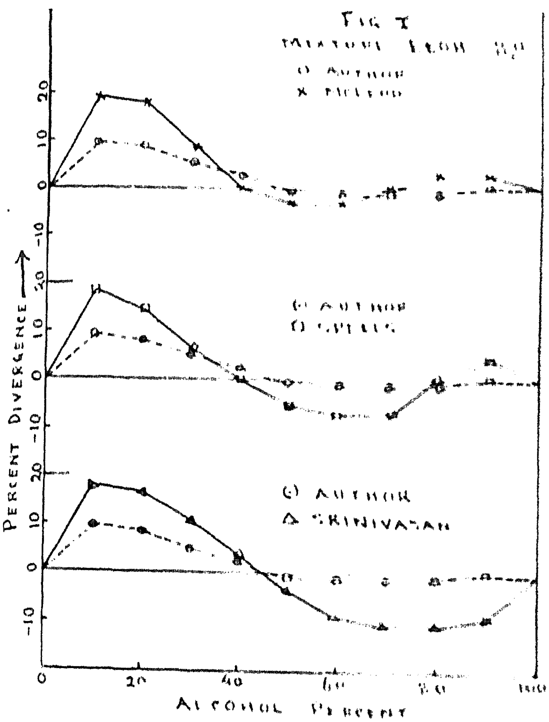
1. Bancroft, W. D., and George, A. B., *Trans. Amer. Electrochem. Soc.*, 1930, **57**, 399. 2. Bennett, A. H., and Donovan, F. K., *Analyst*, 1922, **47**, 146. 3. Vavon, G., and Berton, A. L., *Bull. Soc. Chim.*, 1925, (**4**) **37**, 298.

AN EQUATION FOR THE VISCOSITY OF NON-IDEAL LIQUID MIXTURES

AN equation developed on the basis of Newton Friend's[1] Rheochor, in which account has been taken of the change in density occurring on mixing two liquids, is found to represent satisfactorily the viscosity variation of non-ideal liquid mixtures with their composition. This may be stated as:

$$\eta^{\frac{1}{8}} = \left(\eta_1^{\frac{1}{8}} \cdot \frac{M_1}{\rho_1} \cdot x + \eta_2^{\frac{1}{8}} \cdot \frac{M_2}{\rho_2}(1-x)\right)\left(\frac{\rho}{M_1 x + M_2(1-x)}\right)\left(\frac{\rho}{\rho_1 x + \rho_2(1-x)}\right)^m$$

where η, ρ denote viscosity and density of mixture; η_1, ρ_1 and η_2, ρ_2 the same quantities for



the two components and M_1, M_2 their molecular weights; x the weight fraction of the first component; m an arbitrary constant.

The equation represents data on a number of non-ideal binary mixtures[2,3,4] (showing different types of curves) quite satisfactorily, as will be apparent from a perusal of Table I which gives data for typical cases of good, fair and bad fits. In some cases, the equation agrees with data within much closer limits than other equations (McLeod,[4] Spells,[5] Srinivasan[6]). Thus, for the remarkably non-ideal mixture ethyl alcohol-water, which is not satisfactorily represented by any equation, the maximum divergence with the present equation is 9·7 per cent., as against 18·8, 18·1 and 18·0 per cent. for the other equations mentioned. Fig. 1 shows graphically the percentage divergence from experimental values (for each equation) plotted against composition of the mixture and the curves clearly demonstrate the superiority of the present equation.

TABLE I

Weight per cent. (first component)	Density	η (observed)	η (calculated)	Per cent. difference
Good fit : Pyridine-Benzene : Curve almost linear : $m = 0$.				
0	0·87374	0·006038	0·006038	0
39·73	0·91444	0·007169	0·007059	1·5
59·35	0·93465	0·007726	0·007579	1·9
79·64	0·95564	0·008345	0·008264	0·9
89·77	0·96600	0·008601	0·008367	2·7
100	0·97832	0·008775	0·008775	0
Fair fit : Pyridine-Ethyl alcohol : Curve shows minimum : $m = -1$.				
0	0·79037	0·011532	0·011532	0
29·92	0·84317	0·010340	0·010044	2·9
49·97	0·88449	0·009591	0·009136	4·7
66·07	0·92418	0·008792	0·009077	−3·2
79·96	0·94564	0·008773	0·009107	−3·8
100	0·97832	0·008775	0·008775	0
Bad fit : Ethyl alcohol-Water : Curve shows maximum : $m = 2$.				
0	0·99973	0·01308	0·01308	0
10	0·98393	0·02179	0·01967	9·7
20	0·97252	0·03165	0·02901	8·3
30	0·95977	0·04050	0·03833	5·3
40	0·94238	0·04390	0·04278	2·5
50	0·92162	0·04180	0·04202	−0·5
60	0·89927	0·03770	0·03822	−1·3
70	0·87602	0·03268	0·03315	−1·4
80	0·85197	0·02710	0·02731	−0·8
90	0·82654	0·02101	0·02119	0·8
100	0·79784	0·01466	0·01466	0

The constant m in the equation ranges between $+4$ and -4 in the cases examined and is 0 for mixtures showing almost linear or slightly sagged curves. The corresponding constant in Srinivasan's equation assumes very high values, varying from $+16$ to $-18·5$. As compared to McLeod's two-constant equation, the present equation has one constant only.

Central Research Station,*
Dept. of Agriculture,
Pusa,
November 1, 1946.
A. S. CHACRAVARTI.

1. Newton Friend, *Nature*, 1942, **150**, 432. 2. Dunstan and co-workers, *J. Chem. Soc.*, 1907, **91**, 1728. 3. Baker, *ibid.*, 1912, **101**, 1409. 4. McLeod, *Trans. Faraday Soc.*, 1923, **19**, 17. 5. Spells, *ibid.*, 1936 **32**, 530. 6. Srinivasan, *J. Indian Chem. Soc.*, 1939, **16**, 315.

* This work was done in the Chemical Laboratory, Science College, Patna.

A SIMPLE INEXPENSIVE HAND MICROTOME

IN experiments on suction pressure, permeability and rate of uptake of salts and water by plant cells use is often made of thin discs of potato tuber, carrot, etc.[1,2,3] It is essential to minimize the time lag necessary for the different layers of cells to reach the same stage of water uptake by using sufficiently thin discs of uniform thickness.

In the course of work on the oxidation of potato tubers at this Institute a simple hand-microtome illustrated in Fig. 1 was developed. It consists of a cork-borer, 1·2 cm. in diameter, fitted with a glass plunger which is calibrated into 1·0 mm. marks. The scale is drawn on a piece of paper and introduced into the glass tube. Melted paraffin is then poured into the tube to hold it in position.

In order to operate the apparatus the glass plunger is removed from the cork borer and a symmetrical cylinder of potato tuber is bored out. The plunger is then introduced into the cork-borer and pushed sufficiently in to make contact with the lowest end of the cylinder of potato tuber contained in the cork-borer. The plunger is now pressed in so that the cylinder of potato tuber juts out at the upper end of the borer. A sharp blade is held in level with the rim of the cork-borer and with a quick horizontal sweep a disc is cut from the exposed end of the potato cylinder. First two or three cuttings are discarded as the discs are likely to be uneven. Thereafter the plunger is pressed in gently 1 mm. at a time and discs are cut.

Mean fresh weight per disc in mg. is given for six experiments (each with 25 discs) in table below :—

Mean weight per disc (mg.)

Expt. No.	*Disc wt.*
1	142
2	136
3	138
4	140
5	138
6	133

The agreement appears to be fairly good.

This apparatus has the following advantages over a standard hand-microtome which is generally used by research workers engaged on problems of permeability and absorption and

accumulation of solutes by living plant cells: (*i*) It is simple and inexpensive in design; (*ii*) in the case of a hand-microtome the soft tuber material will have to be either unsupported or mounted in pith which often leads to uneven cutting. The cork-borer used in

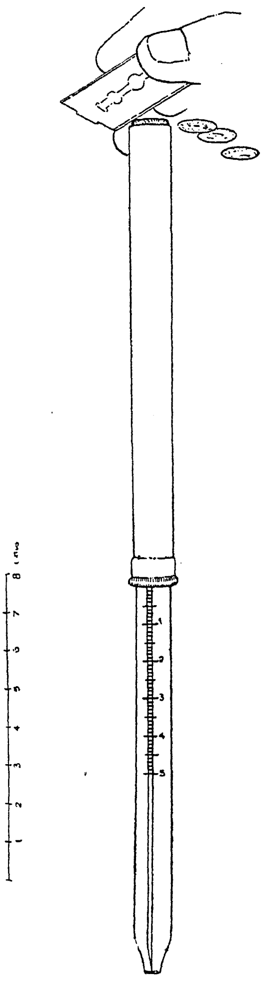


FIG. 1

this apparatus, on the other hand, gives a good support to the material during the process of cutting discs thus ensuring a fairly uniform surface.

For the above-mentioned experiments it is of course necessary to have as thin and even a disc as possible. The ideal condition would be to have only one layer of cells as pointed out by Baptist. It is, however, very difficult in practice to achieve this without injuring the cells. The difficulty is obviously overcome by cutting discs having four or five layers of cells which have been found to sufficiently minimize the time-lag necessary for the different layers of cells to attain equilibrium.

As use of a razor or a razor blade is common to the present arrangement as well as to any standard hand-microtome available in the market the uncertainties of the personal factor are likely to affect the evenness and contour of the cut surface. This constitutes a serious drawback in instruments of this nature.

This defect can, however, be remedied by making use of a mechanical device for cutting sections. Attempts are being made at this Institute to make a hand-microtome with a mechanical device for cutting sections.

In the meanwhile it is hoped that this simple device will prove useful to research workers as well as to teachers for practical demonstration work in physiological laboratories.

Division of Botany,
Indian Agric. Research Institute,
New Delhi, J. J. CHINOY.
December 5, 1946.

1. Baptist, E. C. D., *Ann. Bot.*, 1935, **49**, 345–66. 2. Stiles, W., *Permeability*, London, 1924. 3. Steward, F. C., *Protoplasma*, 1931, **15**, 29–58.

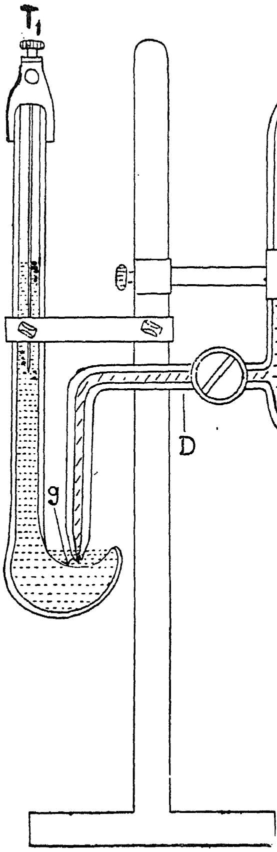
A MICRO-GLASS ELECTRODE FOR pH DETERMINATION

ATTEMPTS[1,2,3,4,5] have been made from time to time to construct glass electrodes of suitable designs. They, however, suffer from serious disadvantages such as difficulties in cleaning and filling, leakage paths necessitating thorough insulation, requirement of 20 to 30 ml. of liquid of unknown pH, high resistance of the system, etc. Claff[2] has recently devised a glass electrode for determination of pH of small quantities of culture media. Great care has to be exercised in preventing air bubbles from vitiating pH measurement with such a glass electrode.

In the course of physiological work on soil-plant growth, a need was felt for designing a glass electrode which could be used with very small quantities of plant extracts. Essential details of such an electrode are featured in Fig. 1.

The conducting membrane *g* (about 25 μ in thickness) is blown in the form of a small cup (15 mm. diameter, 7 mm. depth) in the upper region of an eccentrically blown bulb of (Corning 015) glass of high conductivity which is itself quite thick-walled. The total capacity of the cup is about 1 ml. The bulb is filled with a saturated solution of quinhydrone in 1 N HCl. Contact is made by a platinum wire connected with the gold plated terminal T_1. Contact between the liquid of unknown pH and the saturated calomel electrode C is made by means of the KCl-bridge D in such a manner that the end of the tube rests just above the glass membrane *g*.

Method.—A Cambridge Direct Reading pH Meter calibrated for a range of 14 pH units (Cambridge Instruments for Hydrogen-ion measurements List, No. 108) was found to be suitable in combination with the above electrode system. The standardization of the instrument is checked at frequent intervals.



Comparative pH determinations of buffer solutions

Temperature of solutions — 20–22° C.	
pH by	
Micro glass electrode	Standard glass electrode
3·97	3·98
4·64	4·63
4·58	4·60
4·59	4·59
5·58	6·00
6·89	6·89
7·69	7·70
9·27	9·26
8·69	8·70
2·35	2·35
3·11	3·12
4·23	4·25
5·47	5·45
6·64	6·63
7·94	7·93
9·11	9·12
10·24	10·24

Cleaning of glass electrode cup did not present any difficulty. A small piece of cotton-wool or soft filter paper was introduced to absorb the liquid and the cup was washed 2-3 times by directing a thin jet of distilled water on the end of the KCl-bridge and opening the stop-cock for a moment to flush out the end of the bridge. Once the electrodes were adjusted no need was felt for disturbing their relative positions thus ensuring the safety of the glass membrane. A thin layer of liquid paraffin on the surface of the solution has been found to prevent evaporation quite satisfactorily.

The glass electrode was tested thoroughly by using various standard buffers. The results were compared with those obtained by the standard glass electrode. There is a close agreement between the pH values determined by the micro-glass electrode and also by the standard glass electrode.

Division of Botany,
Indian Agric. Research Institute,
New Delhi, J. J. CHINOY.
December 9, 1946.

1. Clark, W. M., *Determination of Hydrogen Ions*, 1928, 3rd Edn. 2. Claff, C. L., *Science*, 1941, **94**, 285–86. 3. Haber and Klemensiewiez, *Zeit. Physikal Chem.*, 1909, **67**, 385. 4. Kerridge, P. T., *Biochem. J.*, 1925, **19**, 611–17. 5. MacInnes, D. A., and Belcher, D., *Ind. Eng. Chem. Anal. Edn.*, 1933, **5**, 192-200.

A NOTE ON MOSAIC VIRUS OF SANN-HEMP (*CROTALARIA JUNCEA* LINN.) AND ITS CRYSTALLISATION

A MOSAIC disease of sann-hemp (*Crotalaria juncea* Linn.) was found to be of widespread occurrence during the early part of 1946 at Delhi.

The first visible symptom of the disease is mottling of the leaf. As the disease progresses patches of light and dark-green areas become more prominent. A diseased leaf is much smaller than a healthy one (Fig. 1); in the case of severe infection the growth of the lamina is abnormal (Fig. 2). Frequently, the dark-green areas on the upper surface of the lamina are raised with a corresponding depression on the under-surface (Fig. 1).

A microscopical comparison of sections of healthy and diseased leaves revealed some important differences in the mesophyll tissues (Fig. 3). In the chlorotic area of an infected leaf the tissue is thinner with fewer intercellular spaces, and in severe infection the mesophyll is not differentiated into palisade and spongy parenchyma; the cells are more or less isodiametric in transverse section. The chloroplasts in these cells are rather indistinct. No marked abnormality was observed in the vascular tissue of diseased leaves; occasionally, only a few cells in the phloem tissue were found to be hypertrophied.

Inoculation of plants by rubbing expressed sap from diseased plants transmitted the virus; typical symptoms appeared on inoculated plants within six to eight days after inoculation.

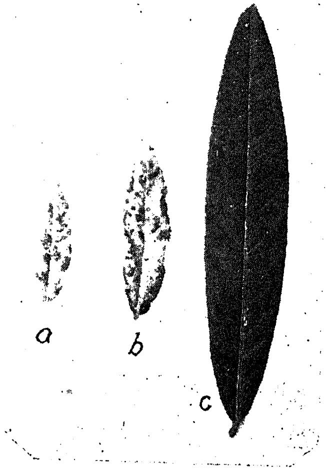


Fig. 1, *a* and *b*, infected leaves of sann-hemp showing typical symptoms of mosaic disease: *c*, healthy leaf of sann-hemp.

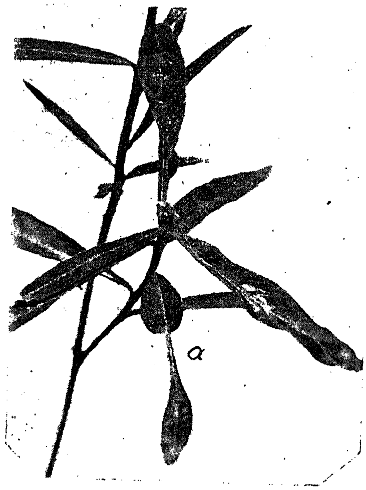


Fig. 2, *a*, abnormal growth of the lamina in a severely nfected leaf.

imilar results were obtained when carborun-um was used as an abrasive. Disease symp-oms were produced within three to four days hen the young leaves were punctured with nsect needles previously dipped in the inocu-um. Control plants were similarly treated vith distilled water instead of expressed sap rom diseased plants; they were included in very test; they remained healthy. Under lass-house conditions the leaves of inoculated lants are affected from a very early stage of heir development.

The virus has a thermal death point of 68-0° C., a longevity *in vitro* of 71-76 days, and an tolerate a dilution of between 1:1000-: 5000.

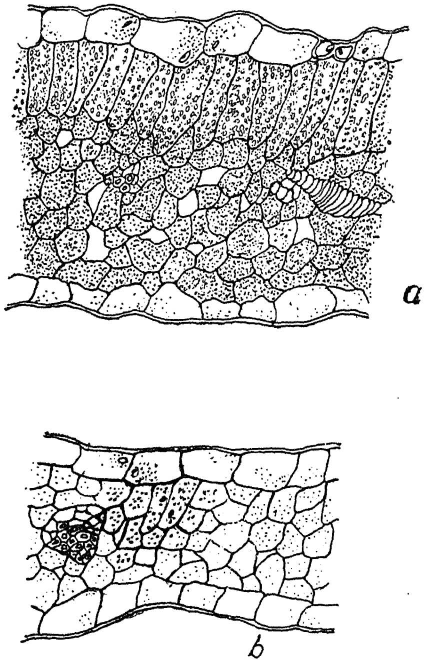
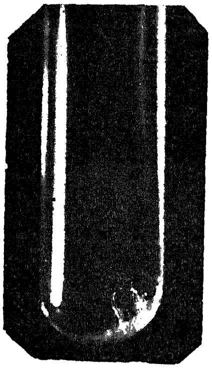


Fig. 3, *a*, t.s. of a healthy leaf × 70: *b*, t.s. of a diseased leaf × 70.



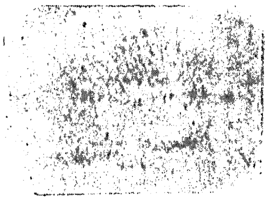


Fig. 4, a white jelly like material accumulated at the bottom of the centrifuge tube.

Fig. 5, acicular crystals of sann-hemp mosaic virus × 10

The sann-hemp mosaic virus could not be transmitted to cowpea [*Vigna unguiculata* (Linn.) Walp.], neither could cowpea mosaic virus, which is of very frequent occurrence at Delhi, be transmitted to sann-hemp. Dale[1] reported a mosaic virus of *V. unguiculata* from Trinidad, and concluded from his experiments that the virus of *V. unguiculata* and sann-hemp are one and the same, since the disease could be transmitted from the former to the latter and *vice versa*. The Trinidad virus is, therefore, different from the one collected at Delhi.

Fukushi[2] recorded a mosaic of *Crotalaria juncea* from Japan; since no experimental work was done by Fukushi it is difficult to state if the virus occurring in India is the same as that in Japan.

The virus was purified according to the method suggested by Bawden[3] with acid and ammonium sulphate. A white pericipitate was formed at the bottom of the centrifuge tube after the preparation was centrifuged. The precipitate was repeatedly washed with water; at pH 3·3 the virus went into solution. The preparation was centrifuged at 3,000 r.p.m. in an 'Ecco' Laboratory Centrifuge; no impurity in the form of a precipitate was observed after this centrifugation. The virus was precipitated from the preparation after adjusting the pH to 4·2 by the addition of N/10 NaOH. The suspension was centrifuged; the precipitate was dissolved in NaOH and the pH was raised to 7·0. This solution was finally centrifuged at 3,000 r.p.m. for one hour. A colourless solution of the purified virus was thus obtained.

The preparation was later centrifuged for two hours in a centrifugal field of nearly 12,000 times gravity. A white jelly-like material accumulated at the bottom of the centrifuge tube (Fig. 4). This jelly-like material was dissolved in water and centrifuged again for one hour at 3.500 r.p.m. A glassy crystalline mass accumulated at the bottom of the centrifuge tube. The supernatant was poured off and discarded. A few drops of distilled water were added to the crystalline mass and the preparation was poured off in a beaker which was kept at 20° C. for 4-5 hours to allow evaporation of water. Very fine glassy acicular crystals were formed on the surface of the beaker (Fig. 5).

The expressed sap collected from leaves of healthy sann-hemp plants was subjected to a similar treatment with acid and ammonium sulphate, and centrifugation, as a blank experiment. No jelly-like material or crystals as obtained from the diseased leaves of sann-hemp plants could be isolated; this clearly indicates that they are not a normal constituent of sann-hemp plants, nor was it produced from the reagents used.

A solution of the purified crystalline preparation gave positive results in inoculation tests on sann-hemp plants and produced typical symptoms of the disease.

Further studies are in progress.

Grateful acknowledgement is due to Mr. J. F. Dastur, Imperial Mycologist, for his helpful criticisms and keen interest in the work.

Division of Mycology and Plant Pathology,
Indian Agric. Research Institute,
New Delhi,
November 18, 1946.
S. P. RAYCHAUDHURI.

1. Dale, W. T., *Trop. Agric. Trinidad*, 1943, **20**, 228–35. *2. Fukushi, T., *Trans. Sapporo nat. Hist. Soc.*, 1932, **12**, 130–141. 3. Bawden, F. C., *Plant Viruses and Virus Diseases*, Chronica Botanica Co., 1943, 142–44.

* The original paper was not available; only abstract was seen in *Rev. Appl. Mycology*.

SOME FACTORS AFFECTING THE REFRACTIVE INDEX AND CONSTANT OF MILK

THE refractive index and refractive constant, K, of milk[1,2] having been recently devised, a number of routine environmental factors that might affect their values were investigated.

The high values of R.I. and K of colostrum (cow, R.I., 1·3513, K, 0·2111; buffalo, R.I., 1·3630, K, 0·2134) reach normal levels in three to seven days after parturition, K being the earlier of the two.

The constants vary, within normal limits, from milking to milking and from day to day. The order of variation, however, appears to be unpredictable.

Within normal limits, appreciable differences also exist between the constants of milk from different quarters of the udder. Different portions of a milking, however, exhibit a more or less uniform value of R.I. and a steady rise in the value of K resulting from the progressive fall in density from fore milk to strippings. In all cases the constants of pooled milk lie within normal limits.

A marked effect of change of season on the R.I. of milk is also noticeable. With the change over from dry summer months to rainy season when lush vegetation is available for cattle there is a distinct upward shift of the limits of R.I. as seen in the following table. The limits of K, on the other hand, remain practically the same because of the more or less corresponding rise in density of milk in the rainy months.

TABLE

Limits of R.I. and K in dry and rainy seasons of the year

	Dry season		Rainy season	
	R.I.	K.	R.I.	K.
Cow ..	1·3450 to 1·3470	0·2061 to 0·2075	1·3458 to 1·3480	0·2065 to 0·2076
Buffalo ..	1·3460 to 1·3492	0·2076 to 0·2088	1·3470 to 1·3530	0·2076 to 0·2088

Rigorous heat treatment of milk like boiling for 5 and 10 minutes causes a progressive rise in the values of R.I. and K depending on loss in volume and rise in concentration of milk solids.

In general it is observed that R.I. of milk is affected by factors which affect variations in the solids-not-fat of milk. The refractive constant, however, remains within narrow limits unaffected by many of the natural factors.

My thanks are due to Mr. B. N. Banerjee and Prof. V. Subrahmanyan for their kind interest in these studies.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
December 6, 1946.
K. S. RANGAPPA.

1. Rangappa, *Curr. Sci.*, 1946, **14**, 230. 2. —, *Ibid.*, p 288.

INITIATION OF LACTATION IN HEIFERS AND COWS

FOLLEY, *et al.* (1941) were successful in initiating lactation in virgin goats by rubbing diethylstilbesterol ointment on the udder. Similar results were obtained by Folley and Malpress (1944) in the case of heifers.

Two barren heifers and one dairy cow were treated with stilbesterol-dipropionate dissolved in oil. To start with all the three animals were injected 2 ml. (containing 20 mg. of stilbesterol-dipropionate) of the oestrogen. Two more injections were subsequently given.

The heifer No. 314 showed mammary development within a week. The little milk that was secreted was mixed with some blood. Intense manipulation of the udder was started and after about a week the animal's milk yield increased to 2 lbs. After a fortnight the milk became normal in appearance. The milk yield had gone up to 15 lbs. per day in 90 days after the milking was first started.

The heifer No. 445 began secreting milk about a week after the second injection and cow No. 332 came in milk a week after the first injection of stilbesterol-dipropionate.

Details of the milk yield and composition of milk are shown in the table. At the start of the lactation the milk obtained closely resembled normal milk rather than colostrum. The total proteins, solids-not-fat and chlorine were rather high and lactose percentage low compared to normal milk. The composition became almost normal after about three weeks.

The animals treated with stilbesterol-dipropionate continued to be in good health throughout the period of study. This treatment has given very promising results which may be extended with benefit on a large scale to initiate milk in barren heifers and cows whose number forms a considerable part of the cattle population of this country.

Yield and composition of milk secreted by animals treated with stilbesterol-dipropionate

Injections given	Days milking started after injection	Days in milk	Daily milk yield lb.	% Composition of milk: Fat	Solids not-fat	Total proteins	Lactose	Chlorine
Heifer No. 314.								
	←—	—→						
	—	7	1·0	3·5	11·64			
2 ml. ..	7	14	2·0	5·7	10·14	5·63	4·04	0·111
(1—4—46) ..	14	21	4·2	5·8	10·08	4·91	4·61	0·111
3 ml. ..	21	28	4·4	7·0	10·52	4·86	5·23	0·110
(11—5—46) ..	28	35	6·0	6·6	10·07	4·76	5·60	0·111
2 ml. ..	60	67	13·5	6·1	10·12	4·23	5·33	0·086
(2—6—46) ..	90	97	15·1	6·3	10·52	4·25	5·25	0·069
Heifer No. 445.								
	←—	—→						
2 ml. ..	—	50	0·6	4·3	10·48	5·55	4·04	0·159
(1—4—46) ..	7	57	1·1	4·7	10·15	4·56	4·71	0·123
2 ml. ..	14	64	2·9	5·2	9·80	4·18	4·97	0·106
(11—5—46) ..	21	71	3·4	6·1	9·87	4·25	5·10	0·102
2 ml. ..	28	78	4·0	6·5	9·63	4·20	5·14	0·079
(2—6—46) ..	60	110	4·7	5·8	9·25	3·95	4·90	0·069
	90	140	3·9	5·8	9·43	3·95	4·95	0·062
Heifer No. 332.								
	←—	—→						
	—	7	2·7	4·6	13·10	8·37	4·49	0·135
2 ml. ..	7	14	4·1	5·2	11·23	6·55	4·92	0·092
(26—5—46 ..	14	21	4·2	5·8	10·10	4·83	5·07	0·092
2 ml. ..	21	28	5·9	5·6	10·26	4·60	5·04	0·080
(15—6—46) ..	28	35	5·4	5·9	9·79	4·33	5·02	0·079
2 ml. ..	60	67	5·6	6·7	9·58	4·30	5·16	0·072
(6—7—46) ..	90	97	5·7	6·2	9·91	4·12	5·06	0·057

The authors thank Mr. M. C. Rangaswamy, Director of the Dairy Research, for his helpful suggestions.

Imperial Dairy Research Institute, Bangalore,
December 16, 1946.

D. NARAYAN.
V. R. BHALERAO.

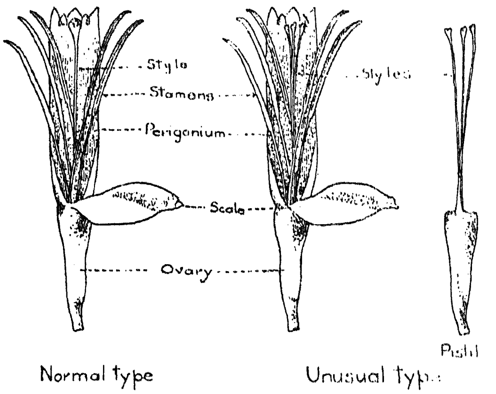
1. Folly, S. J. and Malpress, F. M., *J. Endocrinology*, 1944, **4**, 37. 2. Folly S. J., Watson, H. M. and Bottomly, A. C., *J. Dairy Research*, 1941, **12**, 24.

FLOWERS WITH THREE STYLES IN *MUSA SAPIENTUM* LINN.

Musa sapientum Linn. (*M. paradisiaca* Linn.) is trimerous in its floral organs. In a normal flower, the inferior ovary carries on it the irregular perianth in two parts, one called the

perigonium representing five perianth lobes, and the *scale* representing the sixth. Variations in number and shapes of the perianth parts have been recorded by K. C. Jacob.* Besides the five stamens which are usually found, the sixth rudimentary or fully developed one has been very often met with. Of the gynoecium, the ovary is three-carpelled and syncarpous, style single and stigma also single with undulating surface.

An unusual type with flowers having three styles was met with in one plant of the local variety, Ney Mannan (*vide* Fig.). Many of



the flowers in the inflorescence of this plant were of this unusual type mixed with the normal single styled flowers. Except for the division of the styles to the base, there was no other variation.

Transverse sections of the styles of the normal type and the unusual type were compared. While the normal style has three vascular strands running up to the stigma, there was only one vascular strand in each of the styles of the unusual type, thus showing it to be a simple division of the style into three.

Madras Herbarium, S. N. CHANDRASEKHARAN.
Coimbatore, D. DANIEL SUNDARARAJ.
December 16, 1946.

* Jacob, K. C., *Monograph on Madras Bananas* (Unpublished).

A NEW RECORD FOR *FRITSCHIELLA TUBEROSA* IYENG.

Fritschiella tuberosa Iyeng., a rare member of the order Chætophorales, is a subaerial alga which grows on drying cakes of mud in freshwater ditches. Its peculiar habit and occurrence point the way to the land habit as has been suggested by Iyengar (1932), and also by Singh (1942).

Singh (1941) who worked the autoecology and life-history of the species mentions the relevant literature and also the various situations in which it is found to occur. Iyengar "reported the plant growing on moist silt of drying rainwater pools in Madras, as well as at Talaguppa in the Mysore Province". Randhawa "records its growth in a drying pond and on the banks of the River Sarju", as well as from "fields lying fallow in the Fyzabad District". Singh found it on alkaline land some distance from the Benares Hindu University.

Recently, the author came across this alga in a similar situation to that described by Iyengar. At first it was found growing in association with *Protosiphon* and *Botrydium* as dark-green clusters on sloping ground by the side of a drying ditch seven miles south of Bangalore; and again in a drying pool near Malleswaram, Bangalore. In view of the very few localities in which this species has previously been found the present is an interesting record of its occurrence. What struck the author most, however, was the fact of its occurrence at two places in Mysore State which are situated in climatically diverse regions, Bangalore and Talaguppa being in the *Maidan* and *Malnad* parts of the State respectively.

I thank Dr. M. O. P Iyengar, who found the genus and species, for confirming my determination; and Dr. L. N. Rao for kind encouragement.

Central College,
Bangalore, BASHEER AHMED RAZI.
December 12, 1946.

1. Iyengar, M. O. P., *New Phytologist*, 1932, **31**, 329-35.
2. Singh, R. N., *ibid.*, 1941, **40**, 170-82.

CHROMOSOME NUMBERS IN *SESBANIA* SPP.

RECENTLY two notes[1,3] have been published in this *Journal* giving chromosome number counts in the Indian cultivated species of *Sesbania*. The notes showed that there was some discrepancy between the counts made by different observers. Further counts were made at the Agricultural College, Coimbatore, to find out if there was chromosome number variation within a single species of *Sesbania*. Either mitotic or meiotic chromosomes were counted in five varieties of *Sesbania*. Comparing the present results with previous records, the deductions are, (*a*) autopolyploidy occurs in *Sesbania aculeata*, and (*b*) *S. grandiflora* is probably constant in its chromosome number. The table given below brings out these points.

(*a*) The polyploid numbers in *S. aculeata* may be natural. Mr. Haque's new data[2] may be used to give this interpretation—the Andhra variety of *S. aculeata* is a diploid, and Benares and Coimbatore varieties are autopolyploids.

(*b*) Considering the general consistency in the genus, it is difficult to explain the count recorded by Krishnaswamy, *et al.*[4] In the pollen mother-cells of *S. grandiflora*, there is a considerable amount of secondary pairing and this feature will cause a reduction in the apparent number of bivalents counted at first metaphase. The present counts were made at diplotene, first anaphase, and at second telophase stages, in the P.M.C. in which stages the chromosomes are freer spatially.

Three varieties of *S. grandiflora* were grown at the Millet Breeding Station for this study. The varieties showed differences in vigour and rate of growth. The economic aspect of varietal differences will be studied and published later.

I am indebted to the Millet Specialist, Government of Madras, for facilitating and supervising this work.

Sesbania variety	2 n.	n.	Author
S. speciosa.	12	—	Present count.
S. aeuleata. Benares var.	24	12	Haque.
do. Coimbatore var. .. .	24	—	Present count.
do. Andhra var.	—	6	Sundar Rao.
S. grandiflora Benares var.	24	12	Haque.
do. Andhra var.	24	12	Sundar Rao.
dc. Madras var.	24	—	Present count
do. Coimbatore var.	—	12	do
do. from Paddy Breeding Station, Coimbatore	—	12	do
do. do. ?	—	7	Krishnaswamy, *et al.*

Millet Breeding Station,
Coimbatore, S. SAMPATH.
December 11, 1946.

1. Haque. A., *Curr. Sci.*, 1946, **15**, 78. 2. —, *ibid.*, 1946, **15** 287. 3. Sundar Rao, Y., *ibid.*, 1946, **15**, 78, 4. Krishnaswamy, N., and Rangaswamy Ayyangar, G. N.. *ibid.*, 1935, **3**, 488.

HEMILEIA JASMINI KRISHNAMURTHY AND RANGASWAMI SP. NOV. ON *JASMINUM RITCHIEI* CLARKE

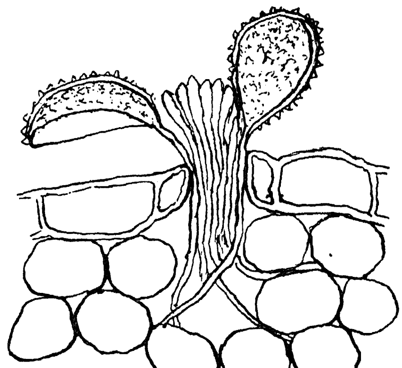
DURING the month of September 1946 widespread incidence of a rust was observed on *Jasminum Ritchiei* growing wild at Yercaud, Shevaroy Hills, Salem District. Mr. K. M. Thomas, Government Mycologist, Madras, had collected a rust on the same host from Coorg in 1925. This specimen was compared with the present collection and the two rusts are found to be the same.

Light orange yellow powdery formation of the sori was present on the lower surface of the leaves. Urediosori were observed in plenty. The sorus was extra-stomatal; a fasciculate mass of hyphæ had developed through the stoma and borne the spores outside the surface of the leaf on short projections (Fig. 1). The spores were sub-globose or resembling the segments of an orange (Fig. 2). The wall was hyaline thicker and echinulate on all sides except the flattened or concave side. The contents were yellowish. The spores measured $24 \times 18\,\mu$ ($17{\cdot}5$–$29{\cdot}8 \times 14$–$24{\cdot}5\,\mu$).

Teliospores were very few. They were irregular, more or less hyaline, thin-walled, smooth and measured $27 \times 22\,\mu$ ($16{\cdot}5$–$38{\cdot}5 \times 14$–$31{\cdot}5\,\mu$). Some of them were hemispherical with the remnant of the stalk on one side; others were angular or other irregular forms (Fig. 3).

Several rusts have been recorded on *Jasminum* spp. from India. They are: *Chaconia Butleri* (Syd.) Mains.,[1] on *J. malabaricum* W.; *Uromyces hobseni* Vize,[2] on several species of *Jasminum*; *Uromyces comedens* Syd.[3] on *J. pubescens* Willd., and *Puccinia chrysopogi* Barclay[4] on *J. humile* L. and *J. Ritchiei*. The last was collected by Mr. Thomas from Coorg in 1925.

The rust now recorded is different from all the above in the peculiar formation of the uredio and teliosori and the characteristic shape of the spores. It is a *Hemileia.*



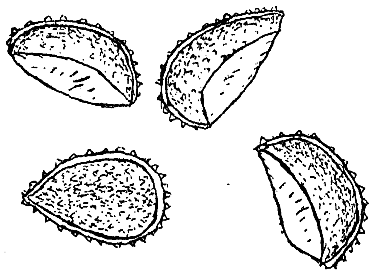


FIG. 1. Section of leaf showing the urediosorus × 660.
FIG. 2. Urediospores. × 660.

No species of this genus has been observed on *Jasminum* or allied genera of Oleaceas till now and, therefore, it is proposed to name this fungus *Hemileia jasmini* sp. nov.

Hemileia jasmini sp. nov. Urediosori Hypophyllous, gregarious, pulverulent, pale orange yellow, minute; urediospores sub-globose to orange-segment shape, $24 \times 18\,\mu$, unicellular, wall hyaline, thicker and echinulate except on the flattened or concave side. Contents light yellow; telia mixed with uredia; teliospores irregular, smooth, hyaline $27 \times 22\,\mu$.

On living leaves of *Jasminum Ritchiei* Clarke. Yercaud, Shevaroys (Salem District), 27-9-'46 (C. S. Krishnamurthy and G. Rangaswami) type deposited in the Herbarium of the Government Mycologist, Coimbatore, and Herb. Crypt. Ind. Orient., New Delhi.

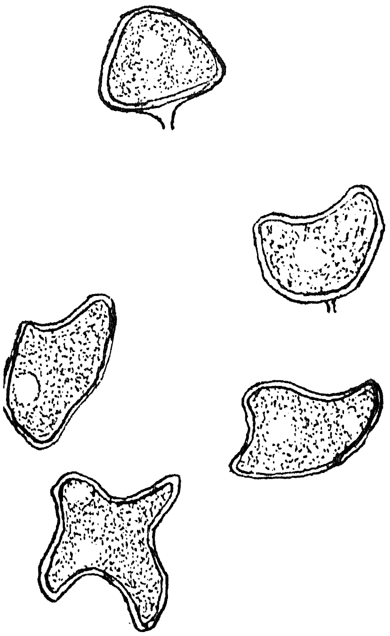


FIG. 3. Teliospores. × 600.

Hemileia jasmini sp. nov. Uredosori hypophylli, gregarii, pulverulenti, levis aurantini—flavi coloris minutissimi; uredeiosporia variantia sub-globosa ad aurantini—segmentiformia, 24 × 18 μ continua, paries hyalinus, crassuset echinulatis, non vero super planum vel concavum latus contenta levis flavi coloris; telia ur.diis mixta; teliospora, irregularia, hyaline laevia 27 × 22 μ.

In vivi foliis *Jasmini Ritchiei* Clarke. Yercaud, Shevaroys (Salem District) 27-9-1946 (Leg. C. S. Krishnamurthy et G. Rangaswami). Typi specimina deposita in Herbario, Governm.nt Mycologist, Coimbatore, et Herb. Crypt. Ind. Orient, New Delhi.

Our thanks are due to Rev. Fr. M. Singarayar of St. Joseph's Seminary, Coimbatore, for the Latin translation; to Mr. K. M. Thomas, Government Mycologist, for helpful suggestions; and to the Government Lecturing and Systematic Botanist, Agricultural College and Research Institute, Coimbatore, for identification of the host.

C. S. KRISHNAMURTHY.
G. RANGASWAMI.

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Lawley Road P.O.,
Coimbatore,
November 20, 1946.

1. Mains, E. B., *American Journal of Botany*, 1938, **25**, 678. Saccardo, P. A., *Syll. Fungorum*, **23**, 665. 2. Sydow, H., *et* Sydow, P., *Monographia Uredinearum* **2**, 38. 3. —, *ibid.*, **2**, 37. 4. —, *ibid.*, **1**, 746. 5. Butler, E. J., and Bisby, G. R., *Fungi of India*, pp. 65, 81 and 82.

DEVELOPMENT OF THE FISCHER-TROPSCH PROCESS IN GERMANY DURING THE WAR

A GIST of the developments made in Germany during the war in the Fischer-Tropsch process of making oils and waxes from coal was given in a recent press-release from the Department of Scientific and Industrial Research, London.

Altogether nine plants seem to have been engaged on this process, most of them operating at atmospheric pressure, while some others employed medium pressure of about ten atmospheres. The combined annual output of these plants was estimated at about 570,000 tons of total hydrocarbons, which is less than 8 per cent. of the total German production of oil during the war.

The gasification of hard-coke in normal water-gas generators was the principal method employed for preparing the synthesis gas, the required ratio of $CO : H_2$ (*viz.*, 1 : 2) being obtained either by catalytic conversion of part of the water-gas into hydrogen or by adding the hydrogen-rich gas obtained by cracking coke-oven gas in the presence of steam. Two of the plants prepared the synthesis gas by the direct gasification of brown coal.

The synthesis catalyst used in all the plants had the gravimetric composition of Co = 100, thoria = 5, MgO = 8, and kieselguhr = 200 and was prepared in the usual way by precipitation from solutions of the nitrates and reduced in hydrogen at about 400° C. under carefully controlled conditions.

The reaction temperature employed varied between 180° and 200° C. In order to dissipate the heat of the synthesis reactions, water-cooling devices were incorporated in the design of the reaction-chambers. The process was also conducted in two or three stages, with inter-stage cooling.

The reaction products, which were mainly straight chain paraffins and olefines, were recovered by cooling and adsorption on active carbon. They were fractionated and stabilised by conventional methods. Irrespective of the pressure used, the most efficient plants obtained yields of 160–165 g. of C_4 and higher hydrocarbons per cubic metre of inert free synthesis gas, *i.e.*, about 80 per cent. of the theoretical maximum yield.

While the lower fractions were used as power-fuels, most of the 230–320° cut was converted into "Mersol" soap-substitutes, by sulpho-chlorination, followed by saponification. Part of it was also cracked with soft wax to yield lubricating oils of good quality. The bulk of the soft-wax, however, was oxidised to produce fatty acids for use in the soap industry and in the production of edible fat. Most of the hard wax found application in the wax industry for polishes, paper-impregnation, electrical insulation and the like.

A development worthy of special mention is the "Oxo-synthesis" in which the olefines react with carbon monoxide and hydrogen to form aldehydes. Although developed mainly for production of long-chain alcohols from Fischer-Tropsch olefines, this process is said to be of general application to compounds containing ethylenic linkages and has a great future.

M. V. C. SASTRI.

REVIEWS

Advances in Colloid Science, Vol. II—Rubber. Edited by H. Mark and G. S. Whitby. (Published by Interscience Publishers Inc., New York), 1946. Pp. 453. Price $7.00.

The book is a result of Anglo-American collaboration in presenting an up-to-date review of physico-chemical studies on rubber and related high polymers. The book contains the following sections, each written by a specialist of established reputation on his subject:—(1) Second Order Transition Effects in Rubber and other High Polymers. (2) Crystallisation Phenomena in Natural and Synthetic Rubbers. (3) The Study of Rubber-like substances by X-ray Diffraction Methods. (4) The thermodynamic Study of Rubber Solutions and Gels. (5) Significance of Viscosity measurements of dilute solutions of High Polymers. (6) The Kinetic Theory of Rubber Elasticity. (7) Vulcanisation. (8) Rubber Photogels and Photovulcanisates. (9) Reinforcing and other Properties of Compounding Ingredients.

The contributors have all recognised the fact that the study of natural rubber forms only a part of the broad field of rubber-like polymers and have, accordingly examined their subject from a comprehensive point of view which has thrown light on rubber-problems as a whole. In natural rubber, the isoprene units are all united in a cis-configuration, in the 1, 4-sense, while in synthetic butadiene polymers, there are both cis and trans- arrangements about the double bonds and also unions in the 1, 4-, 1, 2- and 3, 4-sense. A thorough physico-chemical study of long-chain molecules in general can only give the clues which will some day enable the synthetic chemist to produce at his will macro-molecules having a predetermined length and configuration. This book reveals the worldwide attention which this problem is receiving and the rapid progress which has been made in recent years; indeed the day may not be distant when tailor-made molecules will be commonplace materials.

The contributors have taken much for granted from their readers. The experimental technique which have been used for the solution of problems of major significance, have rarely been described. Complicated mathematical equations have been assumed to be common knowledge. The reviewer feels that a few appendices giving detailed information on these points would have added to the value of the book.

The authors have not only summarised modern researches but have examined critically how far the results of different investigators support or contradict one another and have presented a clear picture of the gaps in our knowledge which remain to be bridged. The book will be welcome to all those who are interested in a scientific study of the subject of high polymers.

J. C. G.

Progress in Science. By W. L. Sumner. (Basil Blackwell, Oxford), 1946. Pp. 176. Price 8*sh.* 6*d.* net.

This is a book which will interest the layman as well as the expert who wishes to have a general knowledge of the outstanding achievements of science in fields outside his own. The author has given a clear and popular account of (1) electrons and their uses in electron microscope, radio-location, television, (2) release of atomic energy, (3) jet propulsion and the gas turbine, (4) plastics, (5) chemotherapy including the story of sulphonamides and penicillin, and (6) plantgenetics, mutation of genes and doubling of chromosomes by artificial means. These discoveries open up wonderful possibilities for the well-being of mankind. They indeed herald the dawn of a new age of plenty, health and happiness, if man only has the wisdom not to use them as tools for his own destruction. Whatever happens, researchers having the true scientific spirit will always persue truth for its own sake, for the simple joy of discovery; and the author has done well in bringing out how advances in fundamental science have been responsible for the technological revolutions which we are witnessing to-day. The book is well worth perusal by persons who wish to have a cultivated mind.

J. C. G.

The Practice of Silviculture (5th edition). By R. C. Hawley. (John Wiley & Sons, Inc., New York; and Chapman & Hall, London), 1946. Pp. xi + 354. 70 Figs. Price $4.

Earlier editions of this excellent book appeared in 1921, 1928, 1934 and 1937. During these 25 years great additions to the knowledge and practice of American silviculture have been made and this present edition, revised, enlarged and largely rewritten, is very different from the first edition.

It is intended as a text-book and deals almost entirely with American conditions. It begins by stressing the difference between *silvics* which deals with the fundamental laws underlying the growth and development of single trees and of the forest as a biological unit, and *silviculture* which is the art of producing and tending a forest, that is the appplication of the knowledge of silvics in the treatment of a forest.

The author divides the book into three main parts: (1) Treatment of the stand during the period of regeneration or establishment including a consideration of reproduction methods, (2) treatment of the stand during that portion of the rotation not included in the period of regeneration (this is a consideration of intermediate cuttings), and (3) protection of the stand against injuries of all kinds. Under (1) the following methods are considered:—(*a*) Clear cutting with both artificial and natu-

ral regeneration; (b) the seed tree method; (c) The shelter wood method; (d) the selection method; (e) the coppice method; and (f) the coppice with standards method.

It is refreshing to see this simple classification, for modern forestry has tended to consider modifications of these main methods as entirely separate methods and this tends to confuse the student.

Section 2 on intermediate cutting includes notes on thinnings, improvement and salvage cuttings, pruning and methods of control. Section 3 is comprehensive on all types of protection and is not usually found in text-books on silviculture.

A very welcome inclusion is a list of common and botanical names of the main American tree species.

Of great interest to Indian foresters are the changes of opinion which have occurred from edition to edition. One of the most striking is that in the 1921 edition the statement was made that "A general rule is not to make the first thinnings until the receipts will at least pay expenses". Craib's work on wattle thinnings in S. Africa has obviously had a lot to do with the change to the opinion in this present edition that the first thinnings should be carried out as soon as they are needed provided it appears that subsequent returns will justify the investment.

Some of the facts given in the first and last chapters are important. For example it is not generally realized that scientific American forestry is a very new thing and is still in an elementary stage as is shown by the fact that out of 509 million acres available for timber production only 21 per cent. is under "some technique of timber production" and only 6 per cent. is under fairly intensive management. As the author says, "Most of the forest area is still without any application of silviculture or else under a very simple form of forest management". He rightly stresses the need for the technical training of forest officers and for the education of the general public.

The book, as is usual in American publications, is well printed and well produced and illustrated with clear simple diagrams. It is complimentary to Toumey and Korstian's *Foundations of Silviculture upon an Ecological Basis* (1937) and these two books should be in the library of every forest officer.

A. L. Griffith.

An Introduction to Textile Bleaching. By J. T. Marsh. (Chapman & Hall, Ltd., Essex St., London.) First edition, Demy 8vo. Pp. 512 + 154 Illustrations. 23*sh*. net.

The publication of this extremely useful book fulfils the long-felt need of a co-ordinated account of the extensive research work carried out by different investigators and the large amount of experience gained in the wet processing of textiles. The author has incorporated most of the important information available in scientific journals. The book is a comprehensive survey in what latest advances and the earlier researches have been carefully blended. The sequence of processes is suitably arranged and carefully developed so as to bring out most of the practical and theoretical aspects of this important branch of textile technology.

The book is divided into six parts and each part deals with a specific subject in textile bleaching.

Part I gives an up-to-date account of the chemistry of the various textile fibres and covers 101 pages. The physics and chemistry of cellulose and other textile fibres is so fully treated in the author's own book, *An Introduction to the Chemistry of Cellulose* that this might have been largely omitted from the present volume but for those portions directly related to the bleaching processes. This is followed by Part II dealing with wetting and detergency. A large amount of information has been included in this section but one feels the lack of a systematic arrangement of the various aspects of wetting and detergency.

The scouring and bleaching of cellulosic fibres are dealt with in Part III. A note on the evaluation of desizing agents and on the examination of Kier boiling efficiency would have been welcome. A diagramatic illustration of a modern gas singeing machine should have been included in the portion of 'Singeing'. Bleaching of coloured goods has been summarily disposed off without proper justice and deserves greater attention.

The chemical technology of the most important animal fibres, wool and silk forms the subject matter of Part IV. The physico-chemical aspect of degumming of silk has been well reviewed. The scouring of wool appears to be incomplete without a reference to the useful work of Dr. Zakarias in the field of Collective Chemistry.

The fifth part deals with drying of textiles. The modern development in drying machinery have been reviewed and well illustrated. The sixth section deals with damage to textile fibres and its evaluation. The inclusion of this section is very appropriate and useful from the point of view of the processor.

The book is well illustrated with neat sketches and photographs of most of the important machines used in wet processing of textiles. A chapter dealing with different types of drives, bearings and their lubrication common in such machines would have increased the usefulness of the book all the more. Nevertheless, the book is of great value not only as a text-book but also as a reference book to the processor and the research worker. Mr. Marsh has made a very valuable contribution to textile chemistry literature.

G. M. Nabar.

Fruit Fall and Its Control by Synthetic Growth Substances. By M. C. Vyvyan. (Imperial Bureau of Horticulture and Plantation Crops. Technical Communication No. 18), 1946. Pp. 1-72. Price 3*sh*. 6*d*.

One of the serious problems that confront orchardists all over the world is the loss in yield due to pre-harvest drop of fruits. If this loss, which at times could be considerable, be checked the orchardists would benefit a great deal. The causes of abnormal shedding of blossom, of young fruit, and of nearly mature fruit, has engaged the attention of several of

the horticultural workers in many countries for a number of years in the past. The experiences of these workers have not been easily available in the past except to a limited few. The results of such previous work, although not been very successful, had furnished much useful information to form the basis of more recent attempts at preventing premature fall of fruit.

In recent years synthetic growth substances have been successfully used by practical horticulturists in inducing quicker and better rooting of cuttings of many plants. Some practical results have also been obtained in inducing parthenocarpy and there appears to be great possibilities of successful use of these substances in effecting good grafts. The success attained in these directions have led some workers to test the possibilities of growth substances in retarding fruit fall. The measure of success attained so far, though restricted to some varieties of fruits, has opened up the possibilities of discovering new substances which will work with varieties which have failed to respond to substances now used. The results obtained in controlling fruit drop by the use of synthetic growth substances forms the subject-matter of the publication under review.

The author has done a commendable piece of work in dealing with so many aspects of the work in such brief manner. The publication is divided into six parts. The first part deals with the causes of loss of potential fruit, *viz.*, pre-blossoming losses, shedding of blossom and young fruit and pre-harvest drop. Under each sub-head the various principal and contributory causes are dealt with. In the second part is described the formation of abscission which is the underlying cause of shedding of fruit. The varietal differences to abscission process, causes affecting abscission and the effect of growth substances on this process are discussed. The third part is devoted to the experimental procedure, *viz.*, the different methods tested, systems of recording and presentation and interpretation of the experimental results. The fourth part which is the longest has for its subject the effect of growth substances on pre-harvest drop. A brief tribute is paid to pioneer work of Gardner, Marth and Batjer of which all subsequent works is an elaboration. The varietal difference in response, method and time of application, types of substances used and their concentration, compatibility of these substances with insecticides and fungicides, and their effect on quality of fruit are concisely dealt with. This part is concluded with a reference to other effects of the growth substances such as on disease of fruits, physiological processes, on young developing parts, leaf fall and the harmlessness of the substances to animals, etc. Part five contains practical recommendations and the final part includes tabular summary of the important results cited and a very useful bibliography.

The above publication will be found to be of inestimable value to fruit growers all over the world who are faced with the loss of potential fruit due to pre-harvest drop. The author deserves the thanks of all horticulturists for compiling together such important results not easily accessible and presenting it in such brief manner. It is needless to say that the Imperial Bureau of Horticulture and Plantation Crops has rendered great service in bringing out this very useful publication, the results of which cannot easily be assessed.

L. S. S. K.

SCIENCE NOTES AND NEWS

University of Madras Endowment Lectureships, 1947-48.—The Syndicate will proceed shortly to select persons to deliver lectures under the following Endowments for the year 1947-48. Applications for Lectureships will be received by the undersigned not later than the 15th March 1947. Applicants are requested to give full particulars regarding their qualifications, etc., and the subject selected by them for the lectures. The lectures are to be delivered before January 1948. Separate application should be submitted for each lectureship.

The principal terms and conditions of award are given below:—

(1) *The Maharaja of Travancore Curzon Lectureships.*—Three lectureships of the value of Rs. 250 each, relating to (*a*) Medicine—Clinical, (*b*) Engineering, and (*c*) Agriculture. Applicants should be graduates of the University.

(2) *The Sir Subrahmanya Ayyar Lectureship.*—Value Rs. 250. The lectures should be on a subject connected with Physical Science. Applicants should be graduates of the University.

(3) *The Sankara Parvathi Lectureship.*—Value Rs. 250. The lectures should be on a subject connected with Ancient South Indian History. Applicants should be graduates of the University.

(4) The Sir William Meyer Lectureship.—Value Rs. 1,500. A course of not less than six lectures should be delivered on a subject in Economics. Half of the remuneration will be paid after the delivery of the lectures and the other half after the publication of the lectures.

(5) *The Principal Miller Lectureship.*—Value Rs. 350. A course of not less than two lectures should be delivered on a subject dealing with the Exposition of the Inner Meaning of Human History as disclosing the one Increasing Purpose that runs through the Ages.

(6) *The Dr. Elizabeth Matthai Lectureship.*—Value Rs. 300. A course of not less than three lectures should be delivered on a subject embodying the results of original investigation in some branch of Medicine and Surgery. Preference will be given to a subject having special reference to the requirements of women and children.

(7) *The Sundaram Ayyar-Krishnaswami Ayyar Lectureship.*—Value Rs. 200. The subject of lectures should be one relating to (*a*) Public International Law, or (*b*) Inter-State Relations of Indian States with British Indian Provinces, or (*c*) Comparative Legislation.

(8) *The Diwan Bahadur K. Krishnaswami Rao Lectureship.*—Value Rs. 200. The subject of lectures should be one relating to some aspect of Ancient Indian Culture studied from Original Sources.

(9) *The Father P. Carty Lectureship.*—Value Rs. 200. The subject of lectures should be one connected with Economics with particular reference to Indian conditions.

Lady Tata Memorial Trust: Scientific Research Scholarships, 1947-48.—The Trustees of the Lady Tata Memorial Trust are offering six Scientific Research Scholarships of Rs. 250 each per month for the year 1947-48 commencing from 1st July 1947. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The scholarships are tenable in India only and the holders must undertake to work wholetime under the direction of the head of a recognised Research Institute or Laboratory. The subject of scientific investigation must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Applications must reach by March 15, 1947. Further particulars can be had from the Secretary of the Trust, Bombay House, Bruce Street, Fort, Bombay.

Frans Verdoorn, First Recipient of Mary Soper Pope Medal.—The first Mary Soper Pope Medal of the Cranbrook Institute of Science, Michigan, has been awarded (Dec. 12, 1946) to Dr. Frans Verdoorn, Editor of *Chronica Botanica*, of Waltham, Mass., in recognition of his editorial and international relations work in biology as well as for his researches in cryptogamic botany and the history of the plant sciences.

Dr. Verdoorn, who was born at Amsterdam, the Netherlands, in 1906, came to the U.S.A. in 1940. He is the Managing Editor of the Chronica Botanica Co., which publishes *Chronica Botanica*, "A New Series of Plant Science Books", and *Annales Cryptogamici et Phytopathologici*. He is also Botanical Secretary of the International Union of Biological Sciences and Special Adviser to the Netherlands Indies Department of Agriculture. His principal books are: *de Frullaniaceis I-XVIII, Manual of Bryology, Manual of Pteriodology, Plants and Plant Sciences in Latin America, Science and Scientists in the Netherlands Indies* (with P. Honig) and the *Index Botanicorum*, a biographical dictionary of plant scientists, now in preparation in co-operation with the Arnold Arboretum of Harvard University, with which Verdoorn has been connected since 1941. From January 1947 onwards Verdoorn will issue a monthly biological newsletter, *Biologia*, and an annual review of progress, in international relations and co-operation in science, to be entitled *Pallas*.

Indian Ecological Society.—The Sixth Annual General Meeting of the Indian Ecological Society was held at Delhi in the Botany Section of the Indian Science Congress, on 4th January 1947, at 2 p.m., when Dr. S. L. Hora and Dr. F. R. Bharucha were elected President and General Secretary of the Society respectively for 1947.

Indian Chemical Society.—The 23rd Annual General Meeting of the Indian Chemical Society was held on January 3, 1947, at the venue of the Indian Science Congress at Delhi, under the chairmanship of Dr. J. N. Mukherjee, the President. Election of the Office-bearers, four Members of the Board of Editorial Correspondents, two Honorary Auditors and four Ordinary Members of the Council was announced. Prof. P. Ray and Dr. B. N. Ghosh were respectively elected President and Secretary of the Society. The President addressed the meeting "On the Role of Chemists in the Promotion of Chemical Science, Research and Industries".

We acknowledge with thanks the receipt of the following:—

(1) *The Trematoda (with special reference to British and other European forms).* By Ben Dawes. (Cambridge University Press), 1946. Price 52/6 net.

(2) *Hydraulic Measurements* (II Edn.). By Herbert Addison. (Chapman & Hall), 1946. 21/- net.

(3) *Methods of Plane Projective Geometry* (based on the use of general homogeneous co-ordinates). By E. A. Maxwell. (Cambridge University Press), 1946. 12/6 net.

(4) *Electronic Theory of Acids and Bases.* By Luder and Zuffanti. (John Wiley & Sons, Inc., N.Y., and Chapman & Hall, London), 1946. $3.00.

(5) *Forensic Chemistry.* By Henry T. F. Rhodes. (Chapman & Hall), 1946. 15/-.

(6) *Chemotherapy Yesterday, To-day and To-morrow.* By Fleming. (Cambridge University Press), 1946. 2/-.

ERRATA

Vol. 15, No. 11, November 1946

Page 302, line 24: Under "Aviation Radio", *for* "Ultra violet wave", *read* "Ultra-short wave"; lines 29 and 30: *for* "air port", *read* "air ports"; *for* "aircraft" *read* "aircrafts"; line 31: *for* "maker" *read* "marker". Under "Radio Direction Finding", line 25: *for* "makers", *read* "markers".

Page 304, line 7: Under "Radar and Associated Systems", *for* "impulse-modulated" *read* "pulse-modulated".

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// CURRENT SCIENCE

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METALLURGICAL RESEARCH AND INDUSTRIALISATION*

IN the distant past this country was foremost in metallurgical industry and contributed much to human knowledge of metals and alloys. India was the first country to evolve the composition of some of the well-known alloys. Now in our own time too this country has the distinction of being one of the largest iron and steel manufacturing countries in the world. The Tata Iron & Steel Co., the Steel Corporation of India and the Mysore Iron and Steel Works have contributed to raising India to this place of honour.

During the years of the war, India's steel production reached 2 million tons per year. Other metallurgical enterprises such as the manufacture of alloy steels, ferro-chrome, ferro-manganese, ferro-silicon and aluminium, were also started. But the position is not one for complacency.

THE IMPERATIVE NEED FOR A PROSPEROUS METALLURGICAL INDUSTRY

Although we possess a sizeable iron and steel industry, we are backward in other aspects of metallurgical industry, which cover a very vast field. We are entirely dependent on other countries for high-speed tool and alloy steels, aluminium, magnesium. various ferrous and non-ferrous alloys and their products. In consequence, engineering industries, the manufacture of internal combustion engines, electrical industry, ship-building, aircraft, chemical industries and several other important industries, which depend on metallurgy for the supply of the necessary constructional material, have not grown in the country. If India is to embark on any kind of industrialisation,

* Extracts from an Address delivered by the Hon'ble Mr. C. Rajagopalachari, on the occasion of the Foundation-Stone Laying Ceremony of the National Metallurgical Laboratory, at Jamshedpur, on 21st November 1946.

and achieve success in a reasonable measure, high priority must be given to the proper establishment of metallurgical industries, on an adequate scale. The mineral wealth of the country must be fully exploited. India is not far behind the richest countries in the world in respect of minerals of economic value. Not only clay, limestone, iron ore and gypsum but bauxite, chromate, manganese ore, rutile, monazite, and ilmenite are available in plenty. All these valuable minerals should be worked up for the growing needs of the country and not just exported as hitherto. During the past 30 years India's export of manganese ores ranged from one-fourth to more than half of total world-production. And this mineral is almost entirely absorbed in iron and steel industry.

It has been estimated that in the near future hydro-electrical energy at the rate of over 4 million K.W. will be produced as a result of various hydro-electric projects. A large part of this energy will be available in the vicinity of the raw mineral resources of the country. Electro-metallurgical and electro-chemical industries based on electricity thus available at low cost can play a great role in the industrial life of the country. Our immediate requirements 20,000 tons of aluminium, 5,000 tons of magnesium, 15,000 tons of copper, 60,000 tons of electric furnace steel per year, and large quantities of other electro-thermal products like alloy steels, ferro-chrome, ferro-manganese, ferro-silicon, graphite and carborundum, can be based on this cheap electrical energy.

Scientific Research—an Essential Prerequisite to Progress

For the organisation and progress of industries, scientific research of a high order is an essential prerequisite. Taking the lowest view of the matter, scientific research pays. It helps to increase efficiency of means used to lower cost of production and to evolve new processes and new products. All experience in recent times show that research, pure as well as applied, helps industries earn very handsome dividends. It is no good leaving things entirely to the government or to anyone else. Excepting in a few isolated cases like the Tata organisation and perhaps the tea and jute interests of the country, industries in India, big and small, are not yet alive in adequate measure to the advantages of scientific research. Among the many factors that have been responsible for this state of affairs, there is the vicious circle that we have to face in all progressive endeavour. Without prosperity industry cannot afford research, and without research industry cannot prosper. This circle must be broken, somehow or other, and soon. The responsibility, therefore, falls on Government to help scientific research in the cause of national progress. The Council of Scientific and Industrial Research has, therefore, founded National Laboratories.

Function of the National Laboratories

It is not intended that these National Laboratories should take upon themselves the functions properly belonging to individual or collective industrial concerns in respect of research. The nature of research work intended to be carried on in the National Laboratories is of the kind that is not ordinarily covered by the work of research that can be conducted by industries themselves, by individual concerns or on a co-operative basis. The Government has to be on the watch for new developments in scientific knowledge which may be of economic or social value to the nation. When such developments offer sufficiently attractive openings, the industries will in most instances probably be ready to take them up and develop them. But the Government has to take the initiative, whenever possible, in collaboration with the particular industry, in exploring new ideas on an adequate scale and, in the event of successful development, taking appropriate steps to secure the widest possible application of the results. Applied scientific research has often necessarily to be carried out in a big institution. The National Metallurgical Laboratory will work in the closest collaboration with all the existing research institutes. While carrying out such tasks as devolve on it in connection with metallurgical research, it will endeavour to promote research by the industry itself, individually, or through co-operative organisations, so that the metallurgical industry of India can soon come to rely upon its own strength and initiative. The metallurgical and other industrialists of the country will give the fullest support to this most important National Laboratory.

Science—A Great Unifying Force

We are on the threshold of a future full of trials, heavy duties and great rewards. In the trials and in the duties that await us, scientists and engineers of the country have to take a very large part. They have great opportunities for service, far greater than they had ever before. They will see the whole country rallying round them, howsoever apparently divergent be the views and aspirations of political or other groups. Science is a great unifying force and may save us where religion as practised has not only not availed, but seems to hinder and divide.

THE NATIONAL METALLURGICAL LABORATORY, INDIA

By G. P. CONTRACTOR
(*Council of Scientific and Industrial Research, Delhi*)

IT was during the last war that the Government of India realised that only planned industrial research on the many problems of the chemical, metallurgical and engineering industries could harness the country's vast resources for the prosecution of the war. This realization was given effect to by the creation of the Board of Scientific and Industrial Research in April 1940 and of the Council of Scientific and Industrial Research afterwards. The Council was established to meet the long-felt need of a Central organisation for a co-ordinated prosecution of scientific and industrial research. As the main result of the unbounded energies of Sir S. S. Bhatnagar, Director of the Department of Scientific and Industrial Research, that it was made possible to obtain from the Government of India more than a crore of rupees for the establishment of a number of Research Laboratories to be sited in different parts of India. One of these, namely, the National Metallurgical Laboratory, is to be built at Jamshedpur.

In order to ensure the progress and expansion of the metallurgical industry it was decided by the Council that a National Metallurgical Laboratory be established in India. Accordingly, a Laboratory Planning Committee, under the Chairmanship of Sir J. J. Ghandy, Director, the Tata Industries, Ltd., was constituted to formulate a scheme. The author was appointed the Assistant Director to assist the Planning Committee in the preparation of detailed plans, and Messrs. Ballardie Thompson and Matthews of Calcutta were appointed the Architects. A tentative scheme was first circulated in 1945. This scheme was later on drastically altered on the basis of the suggestions and comments received from research workers of repute in various countries, and principally on the basis of the funds available with the Council. The final scheme recently prepared was approved on the 17th September 1946 by the Governing Body of the Council of Scientific and Industrial Research, and the Foundation-Stone of the Laboratory was laid on the 21st November 1946, by the Hon'ble Mr. C. Rajagopalachari, Member for Education and Arts, Interim National Government.

As stated earlier the Laboratory will be located at Jamshedpur which is the centre of modern metallurgical industries in India. The Tata Industries, Ltd., have generously placed at the disposal of the Council a very suitable site for the construction of the Laboratory. Services, such as electricity, water, gas, sewage and effluent disposals, are available close to the site.

The Laboratory when completed will cover all aspects of metallurgical research, both fundamental and applied, and will also carry out research on ores, minerals and refractories as applied to metallurgy. The preparation of minerals and ores and the smelting of the latter are so definitely a part of the development of the country's metallurgical industries that facilities for mineral research have been provided at the Laboratory, complete with pilot plant equipment for semi-commercial development.

As the metallurgical industry is one of the biggest consumers of refractories, research on this subject has also been associated with that on metallurgy, and that the work on metallurgical furnace design might also be undertaken. Work on refractories will be greatly facilitated by the presence of the ore-dressing and minerals research section with its specialized laboratory and pilot plant assemblies.

In consequence, provision has been made in the final plans of the National Metallurgical Laboratory, for administration, including statistics, library, museum, lecture theatre, etc., chemical analysis, physical chemistry, physics as it affects metallurgical problems, the examination, preparation and smelting of metallic ores, the melting, heat-treatment and working of metals and alloys, research into the structure and physical properties of metals and alloys, the electro-deposition and surface treatment of metals, and research on refractories. Facilities will also be provided for the application of research results to commercial operating conditions and for the study of such conditions as they affect the quality of the products and the efficiency and economy of commercial production. The National Metallurgical Laboratory will work in close collaboration with the other laboratories of the Council, particularly on long-term research of a fundamental nature.

Broadly, the work of the National Metallurgical Laboratory will be divided into the following divisions:—

1. *Physical Metallurgy Division* including thermal, electrical and magnetic tests, experimental heat treatments, pyrometry, X-ray analysis, radiography, optical properties, application of ultrasonics to metallurgical problems, etc.
2. *Metallography Division* including electron and normal microscopy, macroscopy, inclusions study, experimental foundry, making, mechanical working and heat treatment of metals, physical testing of metals at various temperatures, etc.
3. *Chemical Metallurgy Division* including extraction and refining of metals from their similar materials (ore-dressing and mineral beneficiation).
4. *Inorganic Chemistry Division* including analytical chemistry of metals, alloys, ores, refractories, slags, fuels, etc., study of gases and inclusions by vacuum fusion and other methods, micro-analysis, etc.
5. *Physical Chemistry Division* including electro-metallurgy, study of corrosion and protection of metals, surface treatment of metals, polarography, spectrography, study of slag-metal relationship, chemical microscopy, thermo-dynamics, radioactivity, colorimetry, electro-chemistry, electrolytic production of

metals, determination of pH and its application, general electro-chemistry, etc.

6. *Refractories Division* including study of moulding sands, binders and auxiliary materials, thermal and other physical characteristics, physical properties at various temperatures, petrographical study of minerals and refractories, etc.

7. *Survey and Intelligence Division* including survey of raw materials, library, research and technical information service, translation service, scientific liaison, museum, publication and publicity.

Summarily, the Laboratory is meant to function as an up-to-date research centre where knowledge of the fundamental science of physics, physical and inorganic chemistry, metallography, engineering, etc., will be utilized to solve the problems which confront the ferrous and non-ferrous masters and metal fabricators to-day and are expected to confront them even more in the future when competition from foreign countries will have to be met. The Laboratory is also meant to function as a clearing house for information. The Laboratory will give facilities to a number of scholars to an advanced course and will train them in the application of scientific methods to metals industries, so as to enable them to take charge of technological duties in the works. To help and encourage industrialists in the solution of their problems, facilities will be provided at the Laboratory by establishing Fellowship System, first inaugurated at the Mellon Research Institute, Pittsburgh.

The Laboratory will consist of a Main Building housing administrative offices, research laboratories, library, lecture theatre, museum, etc., and a Technological Block comprising large workshop-type laboratories or bays associated with control rooms for semi-commercial scale operation. The Main Building will have three floors. The administrative section is centrally located on the second floor. The actual working floor area on the first floor is approximately 26,000 sq. ft., with an equivalent space on the ground floor and about 8,600 sq. ft. on the second floor. The Technological Block providing a working floor area of about 28,000 sq. ft., has been situated to the south of the Main Building and connected to it by covered ways. The individual laboaratories and the administrative section in the Main Building will be air-conditioned by refrigeration system.

The total cost of construction and equipment of the Laboratory is estimated to be Rs. 42,80,000. Buildings, services, air-conditioning, heavy electrics, etc., are estimated to cost Rs. 25,00,000 and for equipment a provision of Rs. 17,80,000 has been made. The recurring expenses in the initial stages are approximately estimated at Rs. 6,00,000.

HYDERABAD ENGINEERING STANDARDS COMMITTEE

In order to bring the P.W.D. Officers together for the purpose of discussion of their problems and programmes and to benefit by personal contacts, a Conference of the P.W.D. Officers was held for three days in Hyderabad. It was presided over by the Hon'ble Nawab Zain Yar Jung Bahadur, the P.W.D. Member, and was attended by the Chief Engineers, Superintending Engineers and all the Executive Engineers and Divisional Engineers. They visited the Engineering Research Laboratories on the 14th of December 1946 when the various experiments regarding irrigation, building and road researches were shown to them. The next day Dr. S. P. Raju, Director of Engineering Research, moved the following resolution at the Conference:—

"*Resolved* that in view of the importance of accurate determination of strength of materials and their economical use in construction, an Engineering Staandards Committee be formed to work in collaboration with the Engineering Research Department, with the programme of collection of the different engineering materials of the State, their systematic testing and the drawing up of the standards of specifications."

In explaining the need of such a Committee Dr. Raju stated that the fact of American engineers constructing some of the biggest buildings, dams and other engineering structures in the world was due to their confidence in their knowledge of materials and methods of construction derived by extensive testing and standardising of specifications. He referred to the work of the American Society for Testing Materials (A.S.T.M.), American Society of Highway Officials (A.S.H.O.) for Road Standards, Bureau of Reclamation for Irrigation Standards and then to the British Standards Institution.

He was glad that the Government of India had decided to set up an Indian Standards Institution with the object of evolving national standards in respect of structures, materials, operations, practices, etc. He referred to the speech of the Hon'ble Member in which he had said: "In order to get the greatest good out of engineering research there must be a close co-ordination between engineering practice and engineering research" and stressed the need of a body like the Conference of P.W.D. Officers to be associated with researches on materials and their stardardisation.

The Hon'ble Member strongly supporting the resolution mentioned some of the big things he has in view for engineering progress in Hyderabad which would be needing the help of such a Standards Committee and stated that the Research Laboratories and the P.W.D Officers may thus co-operate in a work of great importance and be linked with the National Body of the Indian Standards Institution.

The Proposals were unanimously accepted.

Hyderabad has the good fortune of carrying an Engineer-P.W.D. Member who can, not only administer the Department but also enter fully into its technical details.

A BIO-ÆSTHETIC PLAN FOR INDIA

By M. S. RANDHAWA, I.C.S.

JUST as we are planning the development of industrial and agricultural resources of our country we should also have a national plan for encouraging the growth of fruit, timber and ornamental trees. In drawing the plan we have to consider the choice of trees for each climatic zone of the country and also take into view the soil and irrigation factors. We have also to clarify our ideas regarding the choice of trees for various purposes, *e.g.*, planting road-side avenues, city roads, canal banks, public parks, platforms in railway stations and compounds of private houses. We have to assign ornamental flowering trees, shade trees, timber trees and fruit trees to places where they can best fulfil their function. At present we see the irritating spectacle of fruit trees being grown indiscriminately in the compounds of houses and, timber trees in public parks and city roads.

The Plan

In brief we may sum up our tree plantation plan for India as follows:—

1. *Bio-aesthetic planting* for compounds of private houses, dak bungalows, banks, hotels, universities, colleges, schools, public offices, town roads, public parks and platforms of railway stations. For these places we should select trees with beautiful flowers and foliage to beautify them and to give pleasure to the people. Kachnar, pink cassia, erythrina, milletia, amaltas and gold mohur come under this category.

2. *Roadside avenues of our national, provincial and district highways.*—The sole criteria for selection should be shade plus economic utility. For this purpose, trees which yield timber, fruit and are also shady should be selected such as mahua, mango, tamarind, neem and sheesham.

3. *Canal roads.*—We should plant all canal roads with fruit trees like mango, jaman, kathal, etc. The stones of varieties like langra, dussehri, sufeda and fajri, yield excellent fruit trees which are better than the desi mango. There are thousand miles of canal roads which can be planted with fruit trees thus adding a valuable source of vitamins to the deficient dietary of our people.

4. *Village plantations.*—Fruit, timber and fuel are the main requirements of villages. Fruit trees like mangoes, lemons, papaya, kathal and sweet-limes are recommended for planting in the compounds of their houses, phulwaris and along the bullock runs of their wells fitted with persian wheels. They should be encouraged to plant bakain and mulberry trees in the compounds of their cattle sheds.

I
A BIO-ÆSTHETIC PLAN

We are indebted to Professor Lancelot Hogben for the term "bio-æsthetic planning" which may be defined as conscious planning of the flora and fauna with the object of beautifying the country. Bio-æsthetic planning embraces both the animal and plant sciences, Botany and Zoology, and may be further defined as planned ecology of living beings from the artistic and æsthetic point of view. It includes the plantation of ornamental flowering trees along city roads, in parks, public places and compounds of houses both in towns and villages and development of National Parks for the preservation of beautiful, non-carnivorous animals, and creation of bird sanctuaries. The object of our bio-æsthetic plan for India is the encouragement of plantation of selected ornamental flowering trees in our towns and villages, protection of beautiful hamrless birds like wild ducks, egrets, geese and Sarus cranes by legal declaration of some of our big Jheels (lakes) as bird sanctuaries, and preservation of graceful animals, which are being ruthlessly exterminated, such as black-buck, blue bulls, sambhars and spotted deer in National Parks and zoological gardens in the vicinity of our big towns.

Public places which belong to the community as a whole rather than individuals should claim preference in bio-æsthetic planning. Larger number of persons, especially those who are unable to afford private gardens of their own will thus be able to enjoy the sight

Places Susceptible of Bio-æsthetic Planning

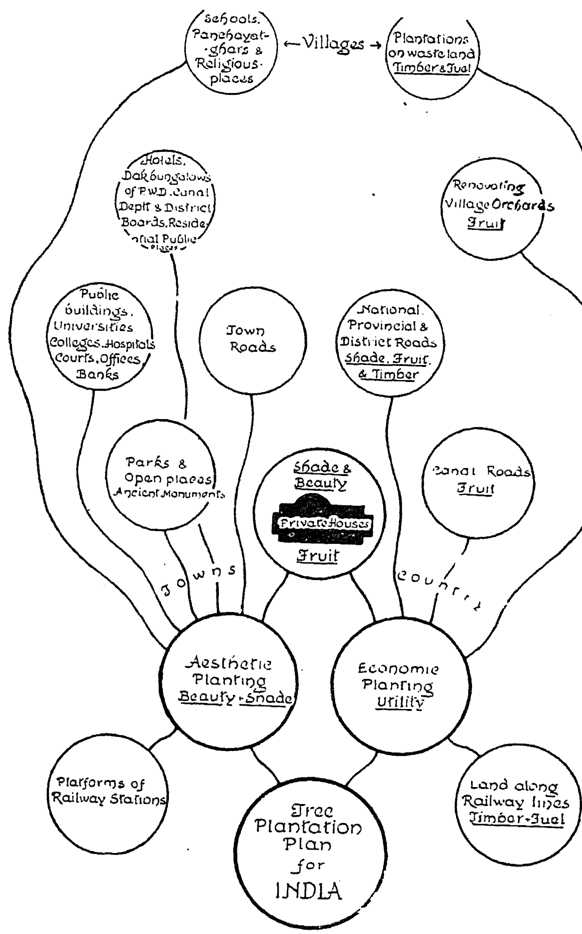
- Towns and Cities
  - Public
    - Town Roads
    - Parks
    - Platforms and approaches of Railway Stations
    - Public Buildings
      - Ancient historical buildings under the Archæological Department
      - Modern Buildings
        - Hotels
        - Dak Bungalows of P.W.D. & Canal Departments and District Boards
        - Universities and Colleges
        - Hospitals
        - Courts
        - Banks
        - Office buildings of Municipalities. District Boards
    - Boulevards in coastal towns
  - Private
    - Compounds of houses
- Villages
  - Ghats of Rivers
  - Panchayatghars
  - Village Schools

of beautiful flowers. Public parks and squares, public roads, platforms of railway stations, compounds of hospitals, universities, colleges and schools, ancient historical buildings under the supervision of the Archæological Department, compounds of courts, office buildings of municipalities and district boards, and dak bungalows of the Public Works Department, Canal Department and District Boards are places in towns which are susceptible of bio-æsthetic planning and should claim preference in our programme for the beautifying of our towns and cities. Proprietors of hotels and banks, and owners of new bungalows should also be encouraged and given all assistance in the planting of ornamental trees.

Firstly they contain no open places suitable fo plantation and secondly their streets and roa are too narrow.

Our Old Towns

Town planning is a precondition of bio aesthetic planting. We have allowed our tow to develop without any plan or order li mushrooms on a dung-heap. In our count *laissez faire* has really gone amock and th results have been most unfortunate. Ugly il ventilated houses joined, together in monstro piles along narrow, crooked lanes—that is ho our ancient towns like Lahore, Lucknow an Benares appear to an outsider whose eyes a accustomed to Western orderliness. An aeri view reveals them as pieces of a jig-saw puz



Town Planning and Bio-æsthetic Planting

Town planning and bio-æsthetic planting go hand in hand. Orderly and planned planting of ornamental trees can be seen to its best effect in new towns with wide roads flanked by shady footpaths, well-laid-out public parks and squares, rather than in congested old towns with narrow crooked streets. Our old towns offer little scope for bio-æsthetic planting.

zle, mixed up in a crazy pile. And not a patch of green in these prison-like piles of masonry. These houses may have been suitable in mediæval, insecure times when security was the guiding principle in our domestic architecture rather than ventilation, but at present they appear anachronisms and fossils of a social and economic order which disappeared long ago. In these old towns, the so-called native quar-

ters and bazars of the Anglo-Indian Sahib, we see a reflection of our disorderly and undisciplined social and economic life. They may appear romantic to foreigners who come to our country in search of oriental mysticism and magic, but are certainly unfit for the growth of a healthy nation. It is time that we reealize that we had enough of these smelly streets. The younger generation must be educated in a new mode of living. We must improve the environment which surrounds the individual in our towns.

Improving Old Towns

A very pertinent question arises about the fate of these old towns. What should be done with these ancient insanitary slums? Some would recommend wholesale demolition. But that is an extreme view, idealistic rather than practicable. These old towns are in need of drastic surgery. We must decongest these old residential areas by compulsorily acquiring suitable central housing areas, and after demolishing the ugly houses thus acquired, we should develop parks and open places in the sites thus vacated. Improvement Trusts have done useful work at Cawnpore, Lucknow and Allahabad, but the rate of progress is snail-like, and painfully slow considering the tempo of modern life and our requirements. In the parks thus made, bathing tanks should be constructed for the enjoyment of citizens in hot weather and incidentally for irrigating the trees and lawns.

As regards the growth and expansion of our towns, control and planning are very essential. All the available land in a radius of three miles or more from the inhabited area according to future needs should be compulsorily acquired by the municipalities and planned into residential areas with commodious plots for houses and wide roads. The garden suburb should be our ideal in this hot country for vertical development is unsuitable considering the summer heat and flats are positively uncomfortable in hot months. Moreover the development of motor transport has greatly facilitated horizontal and peripheral development of towns. So far as possible the growth of these gardens suburbia should be planned in a concentric manner, as this will mean economy in fuel consumption for motor vehicles.

With the planned development as outlined above for our old towns, a good deal of improvement is possible. It will not only provide suitable houses for the man with moderate means, but will also provide a check for the unbridled anti-social activities of the site-gamblers, rack-renters and slum-builders. It is very essential that the Government calls a halt on the process of slummification so that the activities of chawl-builders who are creating problems for the future are curbed, and the colossal waste of wealth of the country on these rows of ugly houses is stopped. With evisceration of slummy quarters, development of parks and tanks in decongested areas, and controlled development in the suburban areas we can make our old towns also fairly attractive.

New Towns

Towns develop along the lines of communications and serve as production or distribution centres. Our old towns have developed along the banks of rivers which were the main channels of communications in the past and served as distributing centres where the villagers exchanged their agricultural produce with hand-made articles manufactured by the artisans of towns. Under the stress of modern industrial development with machine production and rapid means of communications by means of railways and motor vehicles, the old distributing town along the river bank stands as an anachronism. New manufacturing towns will arise in course of time near the source of raw materials, though not to the same extent as in young developing countries like the United States of America and the Soviet Union. Like their Pittsburgh, Detroit, Magnitogorosk, we too will have big manufacturing centres in course of time and Jamshedpore of Tatas is a case in instance. With development of hydro-electric projects industry is bound to spread, but more in the vicinity of existing towns rather than in new sites.

The Garden City

So the problem arises, what should be our ideal in this new town development? The Garden City should be our ideal and the Welwyn Garden City in England, and the Model Town of Lahore provide an example which may be profitably followed in the development of new population centres.

The noisy clanking tram-car with its ugly rails spoiling the streets should be definitely banned in these new towns. With electrification which will follow hydro-electric schemes, trolley-buses will be most suitable for transporting people to the places where they work from their homes in garden suburbs. For our city of the future, Le Corbusier model with many-storeyed offices and factories linked with the garden suburbs by means of bio-æsthetically planted roads, will be very suitable. People will work in the production hub of the city during daytime and will scatter again in the garden suburbs in the evening enjoying their life in healthy, quiet, noise-free and dust and smoke-free surroundings.

Bathing Tanks

Public bathing tanks should form an essential feature of these new towns. People can enjoy themselves in these tanks during summer and their waste water can be used for irrigating the public parks and gardens, which should be planted with ornamental flowering trees. Canals where available can also serve a useful purpose and also provide excellent opportunities for scenic planting and beautifying the towns.

Road Plan and Plantation Plan

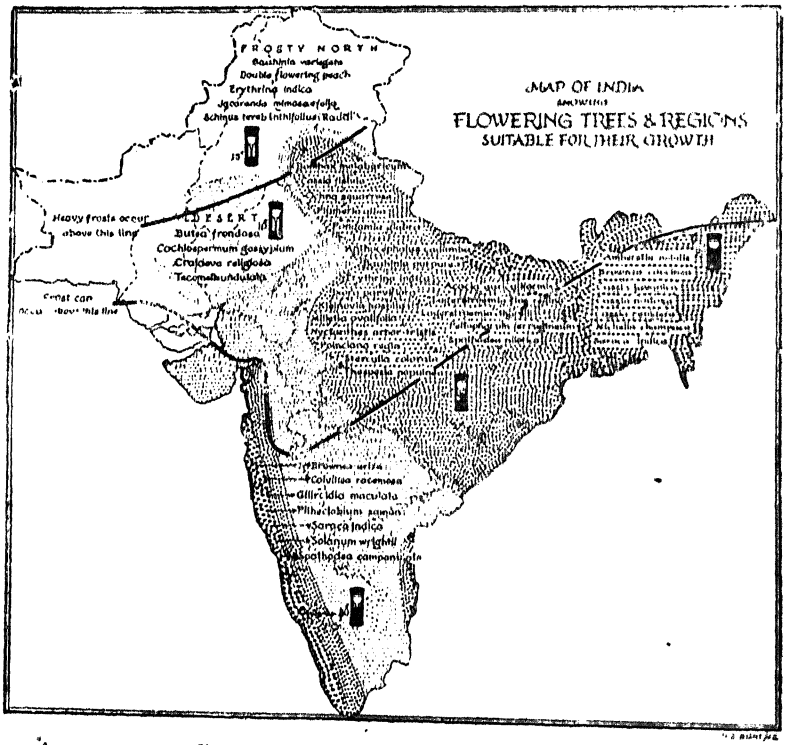
For our towns we are not only in need of 'Road Plan' for traffic but also 'Plantation Plans'. For every town of importance a 'Plantation Plan' should be drawn and rigidly adhered to. For new roads it is comparatively easy to plan plantation of unfamiliar flowering tree, and it is the old roads which present a problem. The wholesale cutting of existing trees will render them shadeless.

Hence the only practical approach is replacement of dead, decaying and old trees according to a plan, and removal of trees planted within two to three years. Once a plan is made, it should be rigidly followed not only in new plantations but also in replacements.

Choice of Trees

While shade and economic utility should be the criteria for selecting trees for national, provincial and district roads passing through the countryside different types of trees are required for town roads. For roadside avenues in towns and cities, shade and beauty are the sole criteria which we should consider while selecting trees. Unfortunately, there are very few trees which combine shade with beauty of flowers, for the large majority of our flowering trees are deciduous. Where space available is so limited and only one row of trees can be grown on each side of the road flowering trees like Gul-mohar, Amaltas, Jacaranda, Erythrina and Spathodea may be grown alternating with shade trees like *Eugenia operculata*. Choice should be restricted to one species only for each street. Very tall trees like Eucalyptus and Millingtonia, and trees with spreading crowns like Banyan, are unsuitable for town roads, for they interfere with electric wires. Medium-sized trees like *Eugenia operculata* and Pakur (*Ficus infectoria*) which are extensively grown in New Delhi, are ideal for shade while for beauty we have a large number of trees to choose from.

traffic such as motor cars and lorries and slow-moving traffic such as horse-drawn vehicles, bullock carts and bicycles. A road divided into four sections for slow and foot traffic on each side separated by islands planted with grass and shrubs in the middle and flanked by footpaths for pedestrians, should be our ideal. We recommend double avenues of trees on outer sides of the footpaths, an outer row of shade-trees and an inner row of ornamental flowering trees. The outer row should be composed of ever-green shade trees with dense foliage, such as Tamarind (*imli*), *Polyalthia longifolia*, *Eugenia operculata*, *Putranjiva Roxburghii*, Moulsari (*Mimusops elengi*), *Ficus retusa*, Neem (*Azadirachta indica*) and Pakur (*Ficus infectoria*). The function of the outer row is of shade only. These trees should be planted in pure avenues and not in mixed patches. Growth in pure avenues provides a beautiful skyline and a pleasing effect due to uniform size and shape of the crowns of the trees of the same species, while a mixture creates an ugly confusion with a jagged skyline. The inner rows should be planted with ornamental flowering trees only. The outer rows of shade trees will provide shade for pedestrians on the footpaths and at the same time will furnish a green background for the pink, red, crimson and yellow flowers of the flowering trees. The trees in both the rows should be planted at a distance of 30 feet from each other with the trees in opposite rows alternating.



Double Avenues for Cities

Double avenues of trees are a necessity in big cities, where wide roads are available. In an ideal road for a traffic centre of the metropolis provision should be made for fast-moving

Some Colour Schemes

While most of the flowering trees look beautiful when planted in pure avenues, there are some species which flower at the same time and the colour of their flowers also harmonizes

and hence appear more effective when planted together. Some of the flowering trees which flower in the same season are grouped below in schemes with due regard to colour harmony and are recommended for planting along our town roads.

SCHEME No. 1

Amaltas	*Gul Mohar*	*Amaltas*
(Yellow)	(Scarlet orange)	(Yellow)

This is a very striking colour scheme, the rich yellow colour of *Amaltas* flowers contrasting with the scarlet orange colour of Gulmohar blooms in the month of May when both the trees are flowering.

SCHEME No. 2

Peltophorum ferrugineum	*Colvillea racemosa*	*Peltophorum ferrugineum*
Rusty Shield Bearer	Colvilles Glory	Rusty Shield Bearer
(Golden Yellow)	(Orange red)	(Golden Yellow

This colour scheme is very effective in October when both these trees are flowering and a colour effect similar to that in scheme No. 1 is produced.

SCHEME No. 3

Jacaranda mimosaefolia	*Grevillea robusta*	*Jacaranda mimosaefolia*
(Blue)	(Yellow)	(Blue)

Both these trees flower in April together and a beautiful colour-effect is produced, which appears soothing in the glare of April sunshine.

SCHEME No. 4

Spathodea nilotica	*Erythrina indica*	*Spathodea nilotica*
Fountain tree	Scarlet Erythrina	Fountain tree
(Orange crimson)	(Scarlet red)	(Orange crimson)

Both these trees flower in March, when they are a blaze of colour.

SCHEME No. 5

Cassia robusta	*Cassia marginata*	*Cassia nodosa*
(Pink)	(Pinkish red)	(Pink)

Both these trees flower in May and June when a very mellow colour scheme of pink and red colour is obtained.

SCHEME No. 6
Bauhinia Scheme

Bauhinia variegata	*B. variegata*	*B. Krugii*	*B. variegata*
(Purple mauve Var.)	(White Var.)	(Light magenta)	(Light pink Var.

This colour scheme which is composed of three varieties of *Bauhinia variegata*, pink, white and purple-mauve, and light magenta (*B. Krugi*) is recommended for dust-free roads of residential areas. All these Bauhinias blossom in a leafless condition from middle of February to middle of March when they look like huge bouquets of pink, white, purple and light magenta flowers. This is a very pleasing colour scheme and is highly recommended.

II
PLANTATION PLAN FOR OUR HIGHWAYS

A plantation plan for our National, Provincial and District Board highways is urgently wanted. In drawing such a plan, climate of a place, its temperature, rainfall, soil and water-level should be carefully considered and suitable species selected.

Avoid Mixtures

On account of indiscriminate planting and thoughtless replacements our roadside avenues have become very much mixed. Due to the difference in the shape of their crowns and rate of their growth they have a patchy appearance and from a distance present a jagged skyline. On the other hand if we plant pure avenues with one species only for a number of miles they will look harmonious and pleasing and the sky-line will be regular and wave-like. So it is very essential that mixtures of different species be avoided and we should have pure avenues of a single species for long stretches. This will not only improve their appearance but also render their management more economic, re-plantation easier and will rationalize their exploitation for commercial purposes. If mahuas and neems are grown in pure avenues for miles, oil-crushing industry can be easily started in such districts. Due to growth in compact areas there will be saving in transport charges. Similarly furniture-making industry can be encouraged in Sub-Himalayan districts which specialize in sheesham, sal and teak. Tamarind fruit which now only serves as a staple diet of monkeys, can be profitably exported to the Punjab, Sind and N.W.-Frontier Province.

List of Ornamental Trees Suitable for Town Roads

No.	Foliage trees for outer Avenue	Flowering trees for inner Avenue
1	*Averrhoa carambola* (*kamrak*)	*Cassia fistula* (*amaltas*)
2	*Callistemon lanceolatum* (Bottle brush tree) ..	*Bauhinia purpurea*; *B. variegata*
3	*Anthocephalus cadamba*	*Colvillea racemosa*
4	*Eugenia operculata*	*Peltophorum ferrugineum* (Rusty shield bearer)
5	*Polyalthia longifolia* (*ashoka*) — ..	*Spathodea nilotica*
6	*Putranjiva roxburghii* (*jia puta*)	*Jacaranda mimosaefolia*
7	*Sterculia alata* (Australian Bottle-necked tree) ..	*Poinciana regia* (*gul mohur*)
8	*Pithecolobium saman* (Rain tree)	*Lagerstroemia flos-reginae* and *L. thorelii*
9	*Melia azadirach* (*neem*)	*Grevillea robusta*
10	*Tamarindus indica* (*imli*)	*Gliricidia maculata*

Mahua flower can be used for the manufacture of power alcohol.

SHADE

The main function of a road-side avenue is shade. Hence those trees which are quick-growing and provide dense shade should be selected. The trees selected should provide shade not only at sides, but also in the centre of the road. From this point of view trees with an umbrella or sub-umbrella crown like neem, mahua, imli and am, are more suitable than trees with a linear, elongated crown like teak, eucalyptus and millingtonia. If these trees provide shade, and also yield valuable timber or fruit, they are still more desirable. The trees should be planted 40 feet apart so that their crowns may develop freely. Where the road is more than 100 feet wide a double avenue of trees with the outer avenue near the boundary line, should be grown. A section of Lucknow-Rae-Bareli road has such a double avenue and the road is very shady and cool.

SELECTION OF TREES

Trees for various roads should be selected with due regard to rainfall, soil, temperature and water-level. Only those trees should be grown along roadsides which provide thick shade and are also valuable from the economic point of view. The following trees which are also shady and yield products of economic value, are recommended:—

(1) Neem (*Azadirachta indica*).—Its leaves and bark are used for medicinal purposes and its seed yields valuable oil. It can grow on alkaline Usar soil.

(2) Mahua (*Bassia latifolia*) fruit is edible and the seed yields an oil. It is also ornamental and its copper-red leaves appear beautiful in the months of March and April. Suitable for clayey soil and can also stand semi-alkaline soil.

(3) Imli (*Tamarindus indica*), a beautiful tree which stands the dust of roads very well, and its fruit and timber are also valuable. Suitable for dry areas.

(4) Sheesham (*Dalbergia sissoo*) yields excellent timber. Suitable for Sub-Himalayan districts with rainfall over 40".

(5) Mango (*Mangifera indica*) yields valuable fruit and dense shade. Suitable for clayey or mixed soil with water-level 30 feet or less.

(6) *Albizzia procera* (*Sufed siris*).—A quick-growing beautiful tree. Grows easily in sandy soils. On account of the light yellow colour of the trunk, it reflects even weak light. An excellent road-side tree.

(7) *Pitheclobium saman* (Rain Tree).—Suitable for moist districts, with rainfall over 40".

TREES UNSUITABLE FOR ROAD-SIDE AVENUES

The following trees should on no account be planted along the roadside:—

I. Brittle Trees—

(1) Eucalyptus (all species).
(2) *Millingtonia hortensis* (Neem chambeli).
(3) *Eugenia jambolana* (Jaman).
(4) *Albizzia lebbek* (Kala Siris).
(5) *Cassia siamea*.
(6) *Ficus glomerata* (Gular).

All these trees are fragile with very weak wood and consequently break easily in a wind-storm. The result is that after a heavy storm roads become blocked and traffic is stopped for a considerable length of time, and during a storm these trees are a positive menace to the lives of unfortunate travellers who happen to be on the road. Besides eucalyptus and neem chambeli have linear, elongated crowns which provide poor shade.

II. Thorny Trees—

(7) *Acacia arabica* (Babul).
(8) *Acacia modesta* (Phulahi).
(9) *Zizyphus jujuba* (Ber).

These are thorny trees and their thorns are a nuisance for pneumatic tyres of small cars, cycles and motor-cycles.

III

IDEAL VILLAGE PLANTATION

Village shamilat, the common land which is used for pasturing cattle, is ideal for village plantations. Old fallow land which has been out of cultivation for a long time can also be taken up for plantation purposes. The question is whether these plantations should be raised and managed by individual farmers or by the village panchayat. Plantation under the supervision of the panchayat and common ownership of the trees is an ideal solution, but the difficulty lies in the lack of corporate sense in many villages. Usually we find that everyone's responsibility is no one's responsibility, and trees planted with great effort are grazed by cattle. So we have to adopt both the remedies. In a village where a panchayat is functioning successfully the plantation should be raised by the panchayat, which can also appoint village youngmen as guards for protecting the trees in the first two years.

In the zamindari and taluqdari villages of Oudh, the waste-land belongs to the zamindar or the taluqdar and not to the cultivators. This is the biggest obstacle in the way of tree-plantation programmes in these villages. The tenants cannot be expected to plant trees for the benefit of zamindars and the zamindars are either too lazy to take up the plantation work themselves or the area of waste-land under their control is too vast and scattered to be planted by them successfully. To overcome this difficulty in the way of progress, the proprietary rights in the waste-lands must be given to the village panchayats.

INDIVIDUAL PLANTATION

In some villages it would be more feasible to partition the village waste-land into units 1 to 5 acres in area. These plots should be enclosed by kutcha-walls to give protection to young trees. Where water table is fairly high, a kutcha-well may also be dug in the plot. Near the boundary wall thorny fuel trees like babul or mesquite (*Prosopis juliflora*) may be planted. In the middle area fruit trees like desi mango and kathal may be planted. The fruit trees may occupy 25 per cent. of the area and the remaining should be covered by fuel and timber trees.

Note.—The cost of printing this contribution has been defrayed by a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India.—*Ed.*

THE NUTRITION RESEARCH LABORATORIES, INDIAN RESEARCH FUND ASSOCIATION, COONOOR, SOUTH INDIA

By Dr. V. N. Patwardhan

THE Nutrition Research Laboratories, Coonoor, occupy a unique and honoured place among the scientific institutions in this country. This status has been achieved within a short period of a little over twenty years. It was in 1918 that Lt.-Col. R. McCarrison (as he then was) commenced work in Coonoor on Beribery Enquiry under the auspices of the Indian Research Fund Association. It had to stop in 1920 when McCarrison was invalided to England. Two years later when he returned to India, the Deficiency Diseases Enquiry was resumed with the generous support of the Indian Research Fund Association. But in a short time it was "axed" as a measure of retrenchment. There were thus two breaks in a short period. Undaunted, Col. McCarrison returned to the charge and in 1925, obtained further assistance from the Indian Research Fund Association. The enquiry this time bore the more comprehensive title of Nutrition Research; Col. McCarrison became its first Director. This attempt was destined to be more fruitful. The Pasteur Institute Association of Southern India had very kindly placed a part of the Pasteur Institute building at the disposal of the Indian Research Fund Association. The Government of Madras loaned the vacant buildings of an old jam factory for use as laboratories and animal house. It is in these two buildings that the Nutrition Research Laboratories have been housed right from the beginning. From a small beginning thus made over twenty years ago the Institution has gradually expanded and has reached its present state. To McCarrison, therefore, India owes a deep debt of gratitude for, it was his genius and foresight, coupled with an immense capacity for hard work, which rendered it possible for the Indian Research Fund Association to build up a first class scientific institution in India devoted to Nutrition Research. For nearly ten years since its inception it remained the only place in India where investigations in nutritional science were being carried out. It seems, however, that the work at the Nutrition Research Laboratories acted as a stimulus to other workers in this country for to-day we find a number of active centres of nutrition research all over India.

Major-Gen. Sir R. McCarrison, I.M.S., retired in 1935 and was succeeded by Dr. W. R. Aykroyd who was well known for his nutrition work on behalf of the Health Organisation of the League of Nations. Dr. Aykroyd guided the destinies of the Nutrition Research Laboratories for the next ten years at the end of which he resigned to take up the post of the Director of Nutrition in the Food and Agriculture Organisation of the U.N.O. in Washington. It is felt that no better tribute to these two men can be rendered than the putting on record an appreciation of their scientific work which has made the Nutrition Research Laboratories what they are to-day.

Almost every educated person in India to-day knows the differences in the physique and health conditions of the people in different parts of India. McCarrison was the first, however, to grasp the scientific significance of the fact. He proved by well-designed experiments that the relative nutritive values of various provincial dietaries was the cause of these differences. He was moreover convinced that at the root of ill-health and diseases in India lay the widespread malnutrition of the people. With the idea of scientifically investigating this aspect in connection with specific diseases that McCarrison undertook studies on goitre and urinary calculus.

From a study of the earlier published work and on the basis of his own observations on human beings and experimental animals McCarrison reached the following conclusions.

The thyroid gland grows more rapidly in early life of the individual than the body as a whole. Its weight, in relation to the total body weight, reaches a maximum at puberty in both sexes and declines thereafter. The gland is more susceptible to dietary influences during the phase of rapid growth. The enlargement of the thyroid under unfavourable conditions may be small and physiological or, on the other hand, may be abnormally great when the condition is called a goitre, the influencing factors being described as goitrogenic. The dietary goitrogenic influences which are the most important may exist either during (*a*) childhood, (*b*) adolescence and/or (*c*) throughout the whole span of life. "In the last event the stigmata of goitre—*i.e.*, congenital goitre, cretinism, deaf-mutism and varying grades of physical and psychic degeneration—appear in the new-born of the species" (McCarrison). Among the goitrogenic influences were (1) excess of fats, fatty acids and lime, (2) deficiencies of vitamins A, C, iodine, etc., and (3) goitrogenic substances present in foodstuffs, such as cabbage, groundnuts, maize, etc. The occurrence or otherwise of goitre depended upon the interplay of these three factors.

The work on goitre has been published in an *Indian Medical Research Memoir*, No. 23, March 1932, entitled "The Life-line of the Thyroid Gland: A Contribution to the Study of Goitre".

McCarrison's work on Urinay Calculi was equally productive of interesting results. It was concluded from hospital statistics collected for the years 1926-28, that in India the incidence of urinary calculus was 1 per 10,000 although it was not uniform throughout India. The "stone area" covers what is known as the wheat

belt, *i.e.*, Sind, North-West Frontier Province, Punjab, and western parts of the United Provinces. In Bombay, Madras, Hyderabad and Mysore, the disease was rarely encountered. There was one interesting observation in this connection and it was that in Manipur in Assam, in the midst of the rice-eating population, the incidence of the stone was again found to be high.

The role of diet in the production of stone was experimentally investigated in the laboratory rat. The stones produced in the urinary tract of the rat on different diets were removed and analysed. These stones were found to be either phosphate stones or calcium stones. In the former case they consisted of magnesium ammonium phosphate and in the latter of calcium carbonate or calcium hydroxide or both. The human stones (removed at operation) were found to consist of a mixture of uric acid or urates, calcium oxalate, calcium phosphate and sometimes magnesium ammonium phosphate. The absence of uric acid or urates in stones in the rat was due to the uricolytic metabolic activity in the rat, which, however, is absent in human beings.

The composition of urinary calculi in cattle was found to be similar to the calcium carbonate stone produced in the rat. The deficiency of vitamin A and imbalance between calcium and phosphorus was shown to be effective in producing stone in rats. The same influences were responsible for stone-formation in cattle. It is true that the mechanism of stone-formation is not fully known even now, but the experiments of McCarrison showed beyond doubt the part played by faulty diets. Further work on this problem is obviously needed.

Although the two main investigations occupied much of McCarrison's attention his wide interest led him to explore other fields such as (*a*) the effect of dietary deficiency on the histopathology of the gastro-intestinal tract, (*b*) relation of rice to beriberi in India, (*c*) Lathyrism, (*d*) nutritive value of Indian foodstuffs, etc.

Dr. Aykroyd's interests lay in the field of applied nutrition. Immediately on assuming charge he commenced systematic study of the dietary habits of population groups and their relation with the prevalence of diseases which could be traced to malnutrition. His pioneer work on nutrition surveys in India was soon followed up by workers in other parts of India, so that by 1940 sufficient material existed to provide a fairly comprehensive although far from complete picture of Indian dietary habits. The information was compiled and published by Aykroyd as a *Note on the Results of Diet Surveys in India.*

In the meantime the Indian foodstuffs were being subjected to analyses in the Laboratories and in 1938 appeared a booklet, popularly known as *Health Bulletin*, No. 23. It contained valuable information on the nutritive value of hundreds of common and uncommon Indian foodstuffs. The researches on (*a*) the pathogenesis of experimentally produced deficiency diseases, (*b*) the physiological function of vitamins, (*c*) insect nutrition and (*d*) clinical research in diseases of chronic malnutrition were also pursued with great vigour by Aykroyd and his associates leading to some interesting results.

A Nutrition Clinic, started at the Stanley Hospital, Madras, with the co-operation of the Surgeon-General with the Government of Madras and the Hospital authorities, has proved a great success. The work done there during the last four years has brought to light important facts concerning chronic diarrhoeas of nutritional origin, the etiology of phrynoderma, skin manifestations of vitamin deficiencies and the burning feet syndrome.

Phrynoderma or follicular hyperkeratosis has come to be accepted as being due to vitamin A deficiency. Aykroyd doubted this, however, and recent studies at the Nutrition Clinic have brought to light what might be called reliable evidence to show that phryroderma is associated not with vitamin A deficiency but with the deficiency of one or more members of vitamin B_2 complex and unsaturated fatty acids.

Burning feet syndrome is a peculiar clinical condition. It had been observed to occur among the poorer population groups in the Nilgiris nearly ten years ago. It actually came into prominence, however, when reports were published at the end of World War II from prisoner-of-war camps in the Far East. In these cases, yeast, yeast extracts or foodstuffs containing vitamin B proved to be effective. Recently at the Nutrition Clinic, Stanley Hospital, several cases of this type were investigated and the therapeutic trials brought out the fact that pantothenic acid had a marked curative effect. Burning feet syndrome thus appears to be a condition due to a deficiency of one of the minor members of the B complex.

During the war years Aykroyd was called upon to advise Provincial and Central Governments and the Indian Army on matters connected with nutrition. He was a member of the Famine Enquiry Commission which was appointed after the Bengal Famine disaster to go into the whole question of (*a*) causes of famines and means of preventing their recurrence, (*b*) possibility of improving the diet of the people and quality and yield of food crops and (*c*) improvements in the food administrative machinery. Aykroyd's wide knowledge of nutrition conditions in India and abroad and his earlier work with the League of Nations must have stood him in good stead in this last of his important tasks in India.

The war did not spare the Nutrition Research Laboratories. On account of its unique position, the advisory work at the Laboratories increased enormously encroaching upon the normal research activities. In other ways too the Nutrition Research Laboratories suffered a great deal. Some members of the staff joined the army, others left for more attractive posts. At that time it was found difficult to fill the vacancies. Further, the supplies of chemicals and apparatus could not be obtained during war years. It is a wonder that in spite of all these difficulties the Laboratories did maintain the output of scientific work not far below the peace-time level.

Neither McCarrison nor Aykroyd singly could have achieved so much without the assistance of a band of enthusiastic workers. They had with them clever, intelligent and hard-working young scientists some of whom are to-day occupying important positions in the scientific world of India. It is invidious to make distinctions by naming one or more individuals for all have given their best. It will be in the fairness of things to state here that their love of science, initiative and loyalty to the institution and to their chiefs have contributed in no small measure to the success of the Laboratories.

Now the Nutrition Research Laboratories are entering a new phase in the post-war India. Till recently the organisation has been functioning as one of the many scattered institutions devoted to the task of preventive medicine considered in its broadest aspect. In future its fate is likely to be linked with the growth of a Central Medical Research Organisation as has been conceived by the Health Surveys and Development Committee of the Government of India. It is inevitable that there should be a great expansion in the scope and activities of the Nutrition Research Laboratories both in the realm of basic and applied researches on Nutrition. When that takes place it will be such that the needs of science and the community are equally well served.

Note—The cost of printing this contribution has been defrayed by a generous grant from the Rockefeller Foundation for the publication of results of scientific work made to us through the kindness of the National Institute of Sciences, India.—*Ed.*

INDIAN ASSOCIATION FOR THE STUDY OF HISTORY OF MEDICINE

At a meeting of the members of the staff of the Madras Medical and the Stanley Medical Colleges, held on the 5th February 1947, the above Association was inaugurated. Major-General Huban who presided over the meeting referred to the history of medicine as a fascinating one which was being studied in America by many Institutions and Societies. Dr. Kutumbiah, Principal, Stanley Medical College, explained the objects of the Association and suggested that the Association could stimulate interest in the subject by organising exhibitions of medical manuscripts, old printed books, paintings and objects pertaining to the History of Medicine.

To promote study of and investigations in medical history, they would collect books dealing with history of medicine of various countries as well as the classics in medicine and place the library at the disposal of scholars interested in special subjects. They expect also to collect some manuscripts and get the co-operation of Sanskrit scholars and Arabic scholars in the study of rare manuscripts and printed works in these languages. Archæologists and anthropologists as well as historians will also be requested to co-operate with them, in the study of the various aspects of medicine. It was also intended to run a Journal on behalf of the Association. Proceedings of the meetings, papers and discussions of original articles, critical studies, reviews of books and lists of publications on history of medicine will in this manner reach the wider public in India and the learned Societies abroad. He hoped that the Society will be able to secure good support from the medical profession and the cultured public in India. He was confident that, with the support of the distinguished members of the profession present on the occasion and of those who have promised hearty co-operation, the Association will soon be able to give a good account of its work and stimulate great interest in the study of history of medicine and make valuable contributions to medical history. He was anxious that the Society should establish contacts with similar Associations, Societies and Clubs devoted to the study of History of Medicine in Europe and America.

Dr. P. Kutumbiah (Stanley Medical College) and Dr. D. V. S. Reddy (Medical College) were respectively elected President and Secretary of the Association.

SUMMARIES OF ADDRESSES OF PRESIDENTS OF SECTIONS INDIAN SCIENCE CONGRESS, DELHI, 1947

POSSIBLE APPLICATIONS OF THE FUNCTIONAL CALCULUS*

STARTING with a single valued function $f(x)$ defined in the closed interval $(0, 1)$, the President outlines the construction of a vector-space of an enumerable infinity of dimensions. Introducing a general concept of integration over a permissible class of sets, the President dealt with the construction of sets of normal orthogonal functions $\phi_1, \phi_2, \ldots \phi_r, \ldots$ and the expansion of a suitable function f as a linear combination $\Sigma a_r \phi_r$. The concept of distance in the function space is introduced in the form $D^2(f, g) =$

$$\int\int K(x, y)\,[f(x) - g(x)]\,[f(y) - g(y)],$$

where $K(x, y)$ is a kernel which may be symmetric or non-symmetric. Writing this right side as $\int (f - g) \times (f - g)$, where the operator Xf is defined as $\int K(x, y)\, f(y)$, integration being with respect to y, a few properties of this operator are set forth.

Some applications of these ideas to statistics, harmonic analysis, etc., are hinted, but we must wait to study in detail when the author publishes his theory in full, and works out the intended applications on a comprehensive scale.

The Indian Science Congress Session and its Proceedings have begun to attract scientists the world over, and it is not in the fitness of things that such Presidential Addresses are printed and got up in such a poor way as to make it an ordeal to read through it. The proofs were not corrected by the author, and a number of errors, printing and otherwise, have crept in.

C. N. S.

* Summary of Presidential Address delivered by Prof. D. D Kosambi, to the Section of Mathematics, 34th Indian Science Congress, Delhi 1947.

DESIGN OF EXPERIMENTS*

"STATISTICS is a young science ... and its potentialities for the advancement of human knowledge and welfare are as yet largely unrealised and unexplored", said Mr. R. C. Bose in his Presidential Address to the Statistics Section. The address is a comprehensive survey of the subject "The Design of Experiments" as it stands to-day with all its theoretical developments, practical applications and unsolved problems necessitating the active interest and patient researches of mathematicians. At the very outset, the important problems of theoretical statistics, *viz.*, heterogeneity of the material, graduation of data, sampling from populations, distribution and estimation of parameters, and testing of hypothesis are vividly explained and work done so far in these fields are briefly indicated. After defining his subject *design* as "The problem of determining 'Optimum' allocation of the experimenter's resources in the collection of the observations", he explains the problem (of design) clearly and shows that the treatment effects to be studied or compared are only linear functions and so are problems in linear estimation; there follows a brief account of the theory of linear estimation from the point of view developed by himself and its connection with the analysis of variance and the well-known Student's t- and Fisher's z-distributions. Based on these ideas the general theory of the analysis of experimental design is developed. Further we have a complete review of the work done so far in the field of balanced incomplete block designs which have been developed in order to overcome "insensitiveness" and to meet economic considerations. Reference is also made to partially balanced incomplete block designs, Latin square, complete and partial Youden square designs. A short peep into the region of factorial designs and confounding forms the finishing touch to this brief picture. In conclusion, a moving appeal is made for establishing a "fruitful co-operation between the experimenter and the applied worker on one hand and the theoretical and mathematical statistician on the other".

M. C. SATYANARAYANA.

* Summary of Prof. R. C. Bose's Presidential Address to the Section of Statistics, Indian Science Congress, Delhi, 1947.

DISORDER IN ATOMIC ARCHITECTURE*

IN his Presidential Address, Prof. Banerjee dealt with the results of X-ray investigations of atomic derangements in crystals which have not been completely understood as yet. After giving a brief review of the experimental work carried out up to the present on the extra reflections in X-ray photographs as well as of the various theories proposed to explain them, the author describes the results obtained by him with crystals of phloroglucine dihydrate and benzil.

In the case of phloroglucine dihydrate the extra reflections are extremely sharp. The central parts of the spots are blank indicating thereby that the central part of the crystals do not show the effect, although the X-ray reflecting power is uniform throughout the entire portion of the specimen. The spots corresponding to $h = 0$ or $k = 0$ are absent. The observed features of the extra reflections in phloroglucine dihydrate cannot be explained satisfactorily on the basis of either the thermal theory or the theory of crystal defect. Prof. Banerjee gives a satisfactory explanation of the observed phenomena on the basis of the modified Raman theory. The extra reflections arise from the excitation of infra-red oscillations by the incident X-rays. The sharpness of the spots in this particular case indicates that the phase waves travel along the c-axis, while along directions normal to the c-axis the atoms should all vibrate in identical phases. This can happen only if one postulates that the

* Summary of Prof. K. Banerjee's Presidential Address to the Section of Physics, Indian Science Congress, Delhi, 1947.

infra-red oscillations excited by the incident X-rays induce same elastic waves travelling along the *c*-axis. The absence of the expected spots lying on the axial lines in the Laue photographs taken with the X-ray beam along the *c*-axis can also be satisfactorily explained by the modifications of the Raman theory suggested above.

In the Laue photographs of benzil taken with monochromatic X-ray beam along the trigonal axis of the crystal continuous lines appear where the layer lines would appear if the crystal were rotated about its three-fold symmetry axes. Similar continuous lines have also been observed in Laue photographs with the X-ray beam along the [10$\bar{1}$0] and [11$\bar{2}$0] directions. These results are suggestive of the existence of derangement waves lying along the planes normal to [10$\bar{1}$0] directions as well as along the basal plane though not so densely. The extreme sharpness of these lines indicates that the derangement waves lie strictly along these planes or have extensions in two dimensions. The continuous lines may, therefore, be considered as extra reflections due to two-dimensional derangement waves. Another feature observed in the case of benzil is the absence of the continuous lines corresponding to the zero layer lines. These facts are explained by Prof. Banerjee on the basis of the Raman theory with the same modification, *viz.*, that the lattice oscillations that are generated inside the crystal due to absorption of X-rays generate elastic waves and the phases of the oscillations over different regions of the crystal are regulated by these elastic waves. It is necessary to suppose that in a crystal such an oscillation may be set up along certain discrete directions, and that elastic waves may be propagated along certain restricted directions.

SOME ASPECTS OF DHARWAR GEOLOGY WITH SPECIAL REFERENCE TO MYSORE STATE*

IN this address Prof. C. S. Pichamuthu has attempted to give a picture of the conditions which probably existed during the Dharwar Period. The Dharwars occur at the present time in isolated strips, remnants of a formation which must once have covered a large portion of Peninsular India. They exhibit variations in stratigraphic succession, dislocations on a gigantic scale, and differences in metamorphic grade, and so the problems presented by them are very complicated and difficult. A most intriguing question that arises whenever we deal with this ancient formation is, whether the Dharwar are the oldest, or whether they were laid down on some pre-Dharwar rock. Prof. Pichamuthu does not consider the Lower Dharwars as the earliest formed rocks. The existence of current bedded quartzites in the Lower Dharwars, and the pebbles of gneiss in the conglomerates of the Middle Dharwars indicate, according to him, the existence of a Pre-Dharwar gneiss which formed the Dharwar basement.

He next traces the history of the development of the idea of the sedimentary origin of the constituents of the Dharwar Schists of Mysore, and suggests that in the Dharwars of Mysore, two distinct sedimentary cycles can be recognised. Each orogenic revolution is accompanied or followed by abyssal injection and volcanic action, and the Dharwars of Mysore illustrate this feature very well, for at the close of each sedimentary cycle there are instances of vulcanism. Leaving aside the probability of a Pre-Dharwar granitic intrusion, Prof. Pichamuthu is of the opinion that there were three separate granitic eruptive epochs, one at the closing stages of the Middle Dharwars, the other at the end of the Upper Dharwar period, and a third which was a very much later one, comprising the Closepet granite and similar pink porphyritic granites.

The Dharwar period covers several million years and so variations in climate are to be expected. There are evidences of both warm climate and an intensely cold spell.

In referring to the life during the Dharwar Period, mention is made of the occurrence of blue green algæ in some cherts.

The discovery of current bedding and graded bedding in the Dharwars of Mysore has opened out new possibilities of working out the complicated tectonics of these rocks.

The topography of Mysore is dependent on the geology of the State and the Dharwar rocks have had a great influence in developing the major landscape features. The ferruginous quartzite which is one of the constituent rocks of the Dharwars is very resistant to weathering, and this explains why the Dharwar Schist region which occupies only one-sixth of the area of the State contains many of the biggest hill ranges in contrast to the Peninsular gneiss region which has reached the stage of peneplanation with only occasional monadnocks. The trend of the Dharwar Schists has also greatly influenced the drainage pattern of Mysore State.

Adequate stress has not so far been laid in Mysore on the stratigraphical and structural aspects of the Dharwars. Textural and structural features such as current bedding, ripple marks, graded bedding, intraformational folds and drag folds will doubtless shed light on stubborn tectonic problems, and help in the correlation of rocks composing the widely scattered outcrops belonging to the Dharwar System. Petrofabric analysis is a technique which is bound to be very useful in this study.

The question of the ages of the different igneous intrusions in the Dharwar period is another important problem which has not as yet been investigated. Radioactivity data and principles afford a mode of attack. Heavy mineral analysis is also a valuable aid for correlating rocks of the same period of intrusion, and for separating suites of rocks of different ages.

The address concludes with the note that while a great deal of work has been done on the Dharwars, much remains yet to be accomplished, for problems which appeared to be

* Summary of Dr. C. S Pichamuthu's Presidential Address to the Section of Geology and Geography, Indian Science Congress, Delhi, 1947.

relatively simple, gather greater complexity as knowledge progresses.

MORPHOLOGY OF THE GYNÆCIUM*

ADDRESSING the Section of Botany, Professor Joshi has covered the welter of controversy in which the morphology of the gynæcium is shrouded. The approach to the problem has lain along varied paths and the number of theories is legion. It is significant that among these, the concept of the Poet-Philosopher Goethe has weathered the storm of controversy and stands to-day with the widest measure of support. Known to botanists as the "Classical Theory" Goethe's doctrine would have the leaf as a morphological constant from which all the other appendages of the stem have arisen. The carpel is equivalent to a leaf folded upwards along its mid-rib and bearing ovules on its incurved margins which unite to form the ventral suture. Evidence for this has come from carpels of several plants and Professor Joshi's observations lead him to believe that the fusion of the carpellary margins can be noticed in the early stages in nearly all carpels, while in Boerhaavia, it persists to the fruiting stage. Thomas' suggestion that one should look for the progenitors of the modern carpel in the reproductive organs of the Caytoniales, and the theory of Carpel Polymorphism have both come in for withering criticism. The inferior ovary is now believed to be of an appendicular nature having arisen by a concrescence of the basal portions of the calyx, corolla, stamens, and the ovary and Professor Joshi working on the Amaryllidæ has made notable contributions in this field. In a reference to the different form of ovules in the Angiosperms, Professor Joshi visualises that mechanical pressures exerted during development along with mutations have together determined the varied types.

K. V. SRINATH.

* Summary of Prof. A. C. Joshi's Presidential Address, to the Section of Botany, Indian Science Congress, Delhi, 1947.

SOME PROBLEMS OF INDIAN ANTHROPOLOGY*

"ONE conviction", says Dr. Karve, "which is forced on every worker in India is that nothing whatsoever is lost either physically or culturally in the peculiar way in which Indian culture is shaped. The primitive lives check by jowl with the latest and the most sophisticated. The unbounded tolerance for other customs, other dresses, other faces and other gods, has resulted in a culture which adds to its repertory of cultural and physical features and never destroys anything deliberately. The process of elimination of the old and the adoption of the new goes on very slowly and never hits the whole population simultaneously. We have the curious phenomenon of castes and tribes following their age-long customs in the midst of the modern world, not because they have no knowledge of the new, but because they think that their way of life is as good as any other. They represent, thus, petrified history and give clues about the time and origin of their migration as about their physical affinities. As social reformers, too eager to impose our standards of life and morals on unlettered communities, we may deplore this vast and varied panorama of social life, but as ethnologists and anthropologists we must make the most of this unique opportunity to record all customs, speech, songs and physical types. An accurate record of this type will help to unravel human history. It will also help a nation which is eager to govern itself, by giving an idea of the mechanism of cultural transformations, about the relativity of moral ideas, about the whole social process it may wish to influence or change."

With very few exceptions, Indian ethnic history has been one of receiving peoples; India has not been a corridor of migration but a blind alley. The main routes of folk and culture migrations were well defined even during the Puranic and historic times. The middle Indian highlands are not so much to be regarded as culture barriers, but as regions of culture contact between the northern and southern cultural areas. Along with several common elements of culture, these two regions have significant differences, particularly in the matter of kinship usages. Light is thrown on the problems of culture contact by the study of migrations and movements of the various beginning with the Brahmins. This leads on to the crucial question whether and how far the bearer of the different caste names are ethnically different as most of them seem to be. The answer to this big question demands more of intensive work both in physical and social anthropology. As a result of the regional surveys of blood groups made so far it has been found, broadly speaking, that there are regions and communities where groups O, A and B are concentrated. A thorough survey of the castes and sub-castes in the Gangetic region "may lead to the pinning down of the B blood group to its proper racial element and to its proper region." The Indian caste system, which is an unmitigated evil socially, provides opportunities for intense research to anthropologists and geneticists. Each caste claims blood relationship of all its members and in the case of the smaller castes the blood tie is no doubt true. The feeling of belonging together is sometimes the result of a caste profession or of common traditions. Different castes may have originated from a common stock or they may have sprung from different stocks altogether. Genetical investigations will, therefore, have to be checked and verified in the light of cultural and historical background. Hence the need for anthropologists taking up this line of investigation. The vast and urgent task awaiting the anthropologists in this country require far greater resources both in men and money.

A. AIYAPPAN.

* Summary of Mrs. I. Karve's Presidential Address to the Section of Anthropology and Archæology, Indian Science Congress, Delhi, 1947.

PSYCHOLOGY AND THE REHABILITATION OF HUMAN SOCIETY*

PROFESSOR NAIDU'S address begins with the observation that the present is the most critical period in the history of human race and compared with the magnitude of the disaster which is threatening the world to-day, the crises in the past history of man pale into insignificance. He is of the view that the phenomenon of war as such is not disquieting, but the regularity and the frequency with which humanity is seized with it, that is really most disquieting. The advance of civilization has helped only to retain the methods by which nations seek the blood of brother nations. At the slightest pretext one nation flings itself at the throat of the other in a fratricidal war; and we are led to ask the question, "What is the remedy ?"—if there is any remedy at all for all these ills. The answer is, "There is hope for man yet ; and that hope comes from psychology."

The professor is of the view that in days gone by people had intuitive or mystical knowledge and that was enough to keep man free from mischief ; but science, which came later, in fullness of time, destroyed spirituality and mysticism and failed to put anything in their stead. To quote the professor, "The rudder has been broken, the ballast thrown overboard, while the winds on the sails are being blown into ferocious violence. The vessel is heading towards the rock and something must be done and done at once to save man from disaster."

There is an encouraging sign, however, and that is, scientists are steadily realising the need for a reorientation of the values of science. The tendency on their part to speak of the social functions of science and to assess scientific achievement in terms of human values is growing steadily. It is being realised both by scientists and political thinkers alike that there is a lag between the achievements of man's brain and the deeper promptings of his heart. There is, no doubt, a feeling among scientists that by reshuffling the environment, human nature may, somehow, be improved ; but it is not realised that without understanding the psychological forces, governing human behaviour, it will be impossible to plan for the improvement of human society. It is, therefore, recommended that in all plans for the future ordering of human society, the findings of applied, experimental and depth sections of psychology should be accorded the place of prime importance. That is, the science of man should be accorded the place that is due to it.

It is stated that the science of psychology prescribes the three grades of Efficiency, Happiness and Self-realisation as worthy of pursuit by man. "Efficiency relates to the body and the spiritual levels of mind, happiness to the deeper mental levels, and self-realisation to the total personality and to the whole being of man." In general, psychology suggests the methods by which human society can be rehabilitated. Applied and experimental psychology will help man to attain efficiency, depth psychology, the attainment of happiness and the spiritual psychology, the realisation of the highest goal of self-realisation.

A plan is then suggested for achieving the efficiency in our National life. An extensive nation-wide survey of the abilities of the boys and girls of all ages and grades, who are now at school, should be undertaken. Along with the medical inspection of children, the listing of intelligence also must be carried out. In the medical inspection charts the results of mental test should be recorded. To prepare the test-material in the various Indian languages, there should be a central Psychological Research Organisation set up. For discovering the innate capacities of children of school-going age tests of special ability should be prepared and applied. By annual re-testing an anxious watch should be kept on the way his ability unfolds itself. In the High School or Polytechnic stage, steps should be taken to train and develop the latent capacity according to strict psychological methods. The data gathered from the psychological tests of intelligence, abilities and temperaments should be subjected to the most up-to-date statistical treatment and the profile drawn for the individual. Job profiles, also, should be carefully prepared. Then remains the task to fit the individual to the job best suited to him. This will account for the attainment of the goal of efficiency. There is, then, need for bringing into being an Indian Institute of Industrial and Applied Psychology. This body will frame and standardise tests and will be charged with the task of organising a Psychological Survey of India. In fact, it will conduct field work on human engineering. Finally, a National Council of Psychology should be entrusted with the task of eliminating avoidable wastage, pain and misery in human society.

Sentiment-building is the process by which culture—individual or racial—comes into existence, and it is here that we must look for happiness. By a process of reasoning, the professor concludes, that no one can hope to plan for happiness by reshuffling the economic structure of society, if he does not have a firm grasp of the psychological forces, which control the economic life of man. He pleads for a psychological orientation of all plans for economic and industrial reorganisation for the reform of society and for educational re-orientation and above all for banishing war. To achieve this it is suggested that a National Psycho-Analytic-Psychiatric Service should be brought into being. Extension Lectures and training in depth psychology should be organised. In fact, the utility of preventive psychotherapy in the daily life of the civilised citizen should be realised.

Finally, for the attainment of self-realisation, which is the final goal of human life, the steps to be followed are also suggested. They are faith in divinity, then the company of holy men and then concentration, meditation and prayer, then taste for spiritual enjoyment, then attachment for the Lord followed by divine love, the final realisation.

Thus the address was a passionate plea for the study of psychology and application of its results and methods as a remedy for the various ills man is subjected to in the present day and for the proper rehabilitation of human society on sound lines.

* Summary of Prof. P. S. Naidu's Presidential Address to the Section of Psychology and Educational Science, Indian Science Congress, Delhi, 1947.

LETTERS TO THE EDITOR

A FUNDAMENTAL RESULT FOR ROTATING RECTANGULAR CARTESIAN FRAMES

In the following is reported a result for a rectangular cartesian frame rotating uniformly with respect to another having the same origin. Although it is simple and interesting it is far from obvious and does not seem to have attracted any attention so far.

Let O-xyz be a frame with respect to which $\dot{x},\dot{y},\dot{z}$ are the velocities and $\ddot{x},\ddot{y},\ddot{z}$, the accelerations of a particle at time t. Let O-XYZ be another frame with respect to which $\dot{X},\dot{Y},\dot{Z}$, $\ddot{X},\ddot{Y},\ddot{Z}$ can be similarly defined. At the instant when the three pairs of axes Ox, OX, Oy, OY and Oz, OZ coincide let one set rotate about the other with constant angular velocity (p, q, r). It can then be verified that

$$(\ddot{x}-\ddot{X})(\dot{x}+\dot{X})+(\ddot{y}-\ddot{Y})(\dot{y}+\dot{Y})+(\ddot{z}-\ddot{Z})(\dot{z}+\dot{Z})=0$$

This implies that *the vector representing the relative acceleration is perpendicular to the vector representing the mean of the velocities.* The verification is made immediate when, for example, one puts

$$X=\dot{x}+qz-ry,$$

$$\ddot{X}=\ddot{x}+2q\dot{z}-2r\dot{y}+pqy+prz-x(q^2+r^2)$$

etc.

The above property came to my notice while Prof. V. V. Narlikar and I were investigating a relativistic problem of rotation.

Kamala Prasad Singh.
The Department of Mathematics,
Benares Hindu University,
January 1, 1947.

ULTRA-VIOLET BANDS OF THE MERCURY IODIDE MOLECULE

The two band systems of the mercury iodide molecule in the region λ 2240-λ 2100, reported by Prilheshejewa[1] and designated by us as the G and H systems,[2] have been newly measured. They consist of about 50 and 25 band heads, definitely degraded to the red. A complete vibrational analysis of the two systems has given the following constants:

		G system	H system
ν_e	=	45542·4	47110·2
ω'_e	=	88·0	97·1
$\chi'_e\omega'_e$	=	0·2	1·65
ω_e''	=	125·7	125·3
$\chi_e''\omega_e''$	=	1·2	1·15

The two systems have a common final level which is known to be the ground state of the molecule. The H system presents an interesting case of predissociation similar to that observed in the β system of NO or the Fourth Positive system of N_2. It consists of just just three v'' progressions of bands with v' = 0, 1 and 2, and the bands show an abrupt termination, those with higher values of v' being absent altogether.

A full report of the work will be published shortly.

Andhra University,
Waltair,
January 9, 1947.

K. R. Rao.
C. Rama Sastry.

1. Prilhesh-jewa, *Phys. Z. Sc[illegible]*. 1[illegible], 1, 1[illegible]9.
2. Rao, K. R. and others, *Ind. Jour. Phys.*, 1944 **18**, 323.

TEMPERATURE AND PRESSURE VARIATION OF HEAT CONDUCTIVITY OF LIQUIDS ON OSIDA'S THEORY

ARGUING from a model of liquid structure similar to that proposed by Andrade[1] in his theory of viscosity of liquids, Osida[2] deduced,

$$K = 4k\,\nu/\sigma \qquad \text{(i)}$$

in which K is the coefficient of heat conductivity of the liquid, k the molecular gas constant, ν the vibration frequency of the liquid molecules, and σ the mean inter-molecular distance.

Temperature increases σ. From Einstein's well-known expression[3] for ν, *viz.*,

$$\nu = C \times 0{\cdot}77 \times 10^{12}\sqrt{T_m/MV^{2/3}} \qquad \text{(ii)}$$

where C is a constant, T_m the melting-point on the absolute scale, M the molecular weight, and V the molecular volume $N\sigma^3$, it follows that

$$\nu \propto 1/\sigma\,;$$

that is, an increase in σ (as a result of temperature rise) is accompanied by decrease of ν. Such a conclusion was arrived at by Macleod[4] from considerations of free space in liquids. A negative temperature coefficient for K is therefore to be anticipated. This result, obtained from theory, is in agreement with the findings of Bridgman[5] in the case of all liquids, except water, which has a positive temperature coefficient. The behaviour of liquid metals also falls in line with the above deduction.[6]

Bridgman[5] has shown that K increases with pressure, the effect being greater for more compressible liquids, and at 75° than at 30° C. Further, the temperature coefficient of all liquids at pressures above 3,000 kg./cm.^{2} is positive. The effect of pressure is to reduce σ causing thereby an increase in ν. The increased conductivity of liquids under pressure is thus explained with more compressible liquids, and at high temperatures, the reduction in σ due to a certain pressure will be more marked than with less compressible liquids and at low temperatures.

The high conductivity of water is due to its associated nature. In associated liquids, apart from the propagation of heat by collisions as postulated by Osida,[1] an addtional factor is the following: When an associated complex arrives at the hotter part of the liquid as a consequence of irregular heat movements, it partially dissociates into smaller units; conversely, when these smaller units come into the colder parts they partially renuite. Since dissociation is accompanied by heat absorption and reformation of complexes by generation of heat, this process would enhance the thermal conductivity. An additional factor is the greater vibration frequency of the smaller units formed in the process. Due to the formation of such smaller units with greater ν at higher temperatures, water has a positive temperature coefficient of conductivity. The positive coefficient of all other liquids, above 3,000 kg./cm.^{2}, investigated by Bridgman[5] might be due to the formation of complexes at such high pressures.

My thanks are due to Prof. S. S. Joshi, D.SC. (London), F.N.I., for his kind interest and encouragement.

Chemistry Department,
Benares Hindu University. S. R. MOHANTY.
January 27, 1947.

1 Andrade, E. N. da C., *Phil. Mag.*, 1934 **17**, 497, 2 Osida, I. *Pro. Phys. Math Soc. Japan*. 1931, **21**, 353 3. Einstein, A. *Ann. der Phys*. 1911 **34**, 170; 1911. **35**, 679 4 Macleod, D. B. *Proc. Phys. Soc.*, 1938 **53**, 788. 5 Bridgman, P. W , *Proc. Amer. Acad.*, 1923 24. **59**. 141. 6. Konno, S , *Tohoku Univ. Sci. Reports*, 19 9, **8**. 169 : Mohanty, S. R., *B.H.U. Journ*, 1946, **9**, 17-32. 7 Mohanty, S. R , *Proc. Indian Sci. Cong*, 1947, **3**, *Phys. Sec.*, **8**.

THE VISUAL SHAPE OF THE OVERCAST SKY

THE problem of the apparent shape of the cloudy sky is one of much interest in meteorological optics. This was partially investigated by Miller and Neuberger[1] in the case of skies covered with 90 per cent. or more of clouds based below 10,000 feet. Their results lead to the surprising conclusion that the half-arc angle[2] decreases with increasing cloud-height; in other words, the sky appears to become flatter with increasing cloud-height. No explanation has so far been suggested for this anomaly. It was felt desirable to examine whether this conclusion holds for overcast skies, whose ceiling lies above 10,000 feet. In view of the uncertain influence on the half-arc angle of differential illumination of the clouds when they are cumuliform,[3] measurements were made by the author only when the skies were totally overcast with the *stratiform* type of medium and high clouds based above 10,000 ft. In this note are reported the results of those measurements. An attempt has also been made to offer a possible explanation for the observed anomaly.

The method of determination of the half-arc angle is the same as described in a previous communication.[4] In order to obviate the effect of partial illumination and differing visibility on the half-arc angle, all measurements were made at about noon-time when the sun was near the zenith and under conditions of good and nearly identical visibility of 20-25 miles. Eight measurements were made at a time in four different directions free from orographic elevations and their mean was adopted as the representative value.

The results reproduced in Table I are the means of a number of representative values for skies overcast with stratified clouds of

TABLE I

Kind of cloud	Average height of base in ft.	Half-arc angle in deg.	Ratio OH/OZ
Thick Altostratus	10 000	27.1	2·73
Thin Altostratus	13,000	26·6	2·80
Thick Cirro stratus	17,000	26·2	2·85
Thin Cirro stratus	22,000	25·4	2·97

approximately the same height of base. In the fourth column of this table are given the ratios of the apparent distances of the horizon and the zenith from the place of observation (OH/OZ), calculated on the assumption of a circular profile for the meridional section of the sky.

The half-arc angles reported by Miller and Neuberger for cloudy skies with average base at 1,200, 3,900 and 8,900 feet respectively are 29°·2, 28°·0 and 27°·2. These values fit in very well with those in the above table, which show a steady diminution with increasing cloud-height. The observed inverse relationship between the half-arc angle and the cloud-height cannot be explained on a geometrical basis, on which, there should indeed be a positive correlation between the two.

The true explanation for the observed anomaly appears to consist in the subjective perception of depth, which varies according to the kind and colour of the cloud. As the author has recently pointed out while discussing the apparent enlargement of the sun and the moon near the horizon,[5] a darker object tends to impress the eye as being more distant and bigger than a brighter one at the same distance, all other conditions remaining equal. The thicker and darker the cloud, the more convex would the overcast sky therefore appear. Amongst the cloudy skies referred to in the above table, the maximum convexity would seem to be associated with the thick and greyish altostratus cloud, which is practically impervious to direct sunlight; and the minimum convexity with the high and whitish cirrostratus cloud, through which the sunlight easily penetrates. In the case of low clouds, the thicker and darker the ceiling, the higher does it look.

One fact of practical interest that emerges from this investigation is that subjective impression considerably influences the visual estimation of the heights of base of clouds. There is a general tendency to under-estimate the heights of medium and high clouds. This tendency is more pronounced, the brighter and thinner the clouds are. The heights of low clouds are overestimated and this the more so, the thicker they appear. It may, therefore, be laid down as a safe rule to follow in utilising data of estimated cloud heights in meteorological work, that the actual heights are higher in the case of medium and high clouds and lower in the case of low clouds than the estimated ones.

In conclusion, the author wishes to express his grateful thanks to Mr. B. N. Sreenivasaiah, Regional Director, Regional Meteorological Centre, Madras, for his kind encouragement during the course of this work.

Meteorological Office,
St. Thomas' Mount,
Madras, D. VENKATESWARA RAO.
January 10, 1947.

1. Miller, A. and Neuberger, H., *Bull. Amer. Met. Soc.*, 1945, **26**, 212–16. 2. Pernter, J. and Exner, F., *Meteorologische Optik*, 1922, 2nd Edn., 5 56. 3. Venkateswara Rao, D., *Proc. Ind. Acad. Sci.*, 1947, **25**, (under publication). 4. —, *Curr. Sci.*, 1946, **15**, 40-41. 5. —, *Ibid.*, 1946, **15**, 227-28.

ZARATITE IN THE NUASAHI CHROME ORE

The presence of zaratite, a carbonate of nickel, in chrome ore has not so far been recorded from any of the chromite deposits of India, viz., the Singhbhum, the Baluchistan, the Mysore and the Madras deposits. The chromite deposit recently discovered at Nuasahi (21° 17', 86° 20') in Keonjhar State has revealed its presence.

It is grass green in colour and earthy in appearance. Seen under the microscope, it is highly pleochroic from green to yellow and has a high refractive index and a high birefringence. It is uniaxial, negative.

The mineral occurs in the inter-spaces between the chromite grains. Further it not only fills in the cracks in the chromite grains but rarely shows some sort of a graphic texture with it. Occasionally it is entirely enclosed in chromite.

The chemical formula for the mineral, according to Dana, is $NiCO_3 \cdot 2Ni(OH)_2 \cdot 4H_2O$ (?). The Indian mineral has not been individually analysed but chrome ore containing this mineral alone analysed 0·3 per cent. nickel and 0·6 per cent. cobalt and 1·8 per cent. water (including moisture). Nickel seems to have been partly replaced by cobalt in the present mineral.

Phillips[1] had ascribed the presence of zaratite in the Shetland chrome ore to the weathering of traces of nickel originally present in the chromite itself or in a nickeliferous olivine.

Department of Mines,
and Geology, Jodhpur S. K. Borooah.
December 6, 1946.

1. *Q. J. G. S.*, **83**, 615.

MALE FERNS OF KASHMIR

MALE FERN is one of the oldest anthelmintic drugs known and was used by the ancient physicians, Pliny and Galen. It is administered in the form of extract filicis for eradicating tape worm infection in man and livestock.

The British Pharmacopoeial Drug is derived from the rhizomes and frond bases of *Dryopteris filix-mas* (Linn.) Schott, a fern indigenous to Great Britain. It should be used within one year of the date of its collection. In America *D. marginalis* A. Gray, which is found in Eastern and Central United States and North to Prince Edward Island forms the source of American Male fern.

D. filix-mas and *D. marginalis* are not indigenous to India but the other ferns belonging to the *Dryopteris* (*Lastrea*) *filix-mas* complex grow wild in the Himalayas in general and in the mountainous ranges of Kashmir in particular. These ferns are:

Dryopteris rasthorni (Diels.) C. Chr.; *D. blanfordii* (Hope) C. Chr.; *D. odontoloma* (Moore) C. Chr.; *D. ramosa* (Hope) C. Chr.; and *D. marginata* (Wall.) Christ.

Considerable quantities of the male-fern extract are annually imported into India for medicinal purposes. In order to study if the

Analytical Data of Ferns D. odontoloma *and* D. marginata

Species	Locality	Calcium oxalate crystals	Percentage of total ash	Percentage of acid insoluble ash	Percentage of *Filicin* in the rhizome	Percentage of *Extractive*	Percentage of Filicin in the extractive	Remarks
D. ODONTOLOMA								
	Gandher bal.	Absent.	3·6	0·51	2·8	10·9	25·6	Up to B. P. & U S.P. standards.
	Pehlgam.	Do.	3·8	0·87	2·3	11·7	19·6	The fern is up to B.P. & U. S. P. standard but the extract falls short of the standard.
	Bosian.	Do.	3·2	0·44	3·1	11·4	27·1	Up to B. P. & U.S.P. standard.
	Bhedi.	Do.	3·1	0·32	2·5	9·4	26·5	Do.
	Latot.	Do.	4·2	0·78	2·1	7·9	26·5	Do.
D. MARGINATA	Tanmarg	Do.	2·9	0·34	3·03	10·9	28·4	Up to B. P. & U.S.P. standard.
	B.P. 1932. Limits.	Do.	Not more than 6%	Not more than 2%	—	—	24–26% W/W	
	U.S.P. XII Limits	—	—	Not more than 3%	Not less than 1·5%	—	Not less than 24% W/W	

N.B.—The methods of B.P. 1932 have been used for the assay of the drug and all the calculations have been done on the basis of the drug dried at 100° C.

above-mentioned ferns growing wild here can be substituted in place of the official ferns and can be used in the manufacture of the expansive male-fern extract imported from abroad, samples of these ferns were collected for this study.

D. odontoloma occurs widely in the fir zones forests as an undergrowth throughout the Kashmir Valley. It is more common on the southern aspect of the forests retaining good moisture at altitudes of 5,000 to 8,500 feet above sea-level.

D. marginata is found at places with comparatively less moisture in the *Pinus excelsa* zone at altitude of 5,500 to 6,500 feet.

Five samples of *D. odontoloma* and one of *D. marginata* was collected from the various localities in Kashmir. All the tests given in the B.P. 1932, and the U.S.P. XII were conducted and the results are given in the table above.

From the perusal of the above results it is apparent that the local ferns are of B.P. and U.S.P. standard and can yield the male-fern extract of B.P. standard for medicinal purposes.

The other ferns of *D. filixmas* complex are under study and their results will be reported in due course.

We have much pleasure in acknowledging the help and advice we have received from Colonel Sir R. N. Chopra, KT., C.I.E., I.M.S. (r.), during the course of this investigation.

The Drug Research Laboratory, K. L. HANDA.
Jammu Tawi. L. D. KAPOOR.
January 6, 1947. I. C. CHOPRA.

A NOTE ON THE CHEMICAL INVESTIGATION OF THE FRUITS OF *CELASTRUS PANICULATA*, WILLD. (*N.O. CELASTRACEAE*)

IN view of a recent paper by Bhargava[1] on the chemical examination of the unsaponifiable matter of the fat from the fleshy arils of *Celastrus paniculata*, we are giving below our findings on the same investigation which was completed two years back.

Bhargava[1] reports the analysis of the fleshy arils of *Celastrus paniculata*. He has isolated a phytosterol (m.p. 142°) and states that it is quite different from the phytosterol isolated by Warsi.[2]

We have extracted the arils with acetone when an orange-red semi solid fat was obtained. The fat was analysed and the composition of the mixed acids of the fat has been found to be similar to the one reported by Gunde and Hilditch.[3]

The unsaponifiable matter was obtained as a sticky orange coloured mass. During purification the orange colour was bleached. The colouring matter appears to be unstable and could not be isolated. After several crystallisations from 95 per cent. alcohol and finally from petroleum ether a white crystalline material was obtained (m.p. 75° and molecular weight 352) (Rast's method). (Found: C, 81·3; H, 13·7; $C_{24}H_{50}O$ requires C, 81·36; H, 41·1 per cent.) It gave an acetyl derivative (m.p. 57°). It is evidently tetracosanol (m.p. 76·5–77°·5), acetate (m.p. 57°; *cf.* Brigal and Fuchs[4]). The

residue from mother liquors from tetracosanol, on complete removal of the solvent, was dissolved in acetic acid when a crystalline mass was obtained. It was recrystallised from dioxan followed by alcohol when it was obtained in flakes (m.p. 149°). It gave all the colour reactions of phytosterols.

Bhargava[1] gives the melting-point of the sterol as 142° and has named this sterol as '*Celasterol*'. However, Gisvold[5] has isolated a pigment from the outer bark of the *Celastrus scandeus* and named it '*Celastrol*'.

In naming a new substance care must be taken to see that the same name has not been used for another substance before. Since the name celastrol has been already given to the pigment isolated from a similar plant, some other name ought to be proposed for the sterol isolated by Bhargava.[2]

M. M. SHAH.
N. L. PHALNIKAR.
B. V. BHIDE.

Maharaja Pratapsinh Chemical Lab.,
Sir Parashurambhau College,
Poona 2,
January 8, 1947.

1. Bhargava, P. N., *Proc. Ind. Acad. Sci.*, 1946, **24A**, 507 (Dec.). 2. Warsi, *Curr. Sci.*, 1940, **9**, 1:5. 3. Gande and Hilditch, *J.C.S.*, 19:8, 1980. 4. Bielaud Fuchs, *Z. Physiol. Chem.*, 19:2, **119**, 280. 5. Gisvold, *J. Am. Pharm.*, 1939, **28**, 440.

CICADELLA VIRIDIS ITS SYMBIOTES AND THEIR FUNCTION

Cicadella viridis was first investigated by Buchner[1] cytologically while Resühr[2] confirmed Buchner's findings working in an institute of microbiology. There are two types of tumours or rather of bacteriotomes. There is a larger greenish yellow in colour and a smaller which is faintly orange in the female but distinctly so in the male. It has not been remarked by previous workers that the ventral surface of the male insect is orange like the colour of its small tumour. It has been observed that the small and the large tumours are separate morphologically. However in the young stage the small or the orange tumour appears like a protuberance of the large or the yellow bacteriotome. It has been explained by me[3] that both contain bacteria and that in the smaller one the red bacterium predominates and in the major tumour a bacterium which produces an olive green pigment.

However according to Buchner only the smaller tumour contains bacteria. As found infecting the egg the germs have been illustrated on p. 138, in his Fig. 19; they are represented as large-sized bacteria as well as relatively small ones. Since bacteria exhibit polymorphism the difference in size can be explained as such.

A cell from the smaller tumour infected with bacteria is illustrated by Buchner in his Fig. 18, which is reproduced here as Fig. 1. The picture shows long threads, indicated by me as *R* for these bacteria produce a red pigment, and smaller bacteria tending to be mere dots, marked by me as *G*, for they produce in old cultures an olive green pigment. As previously[3] mentioned the yellow green bacterium supports the red commensal bacterium so that it is impossible for the long bacterium to form pure colonies in insect tissue; Buchner's Fig. 1 thus represents a mixed colony with the long bacterium predominating as it does in the smaller or the orange coloured tumour. The

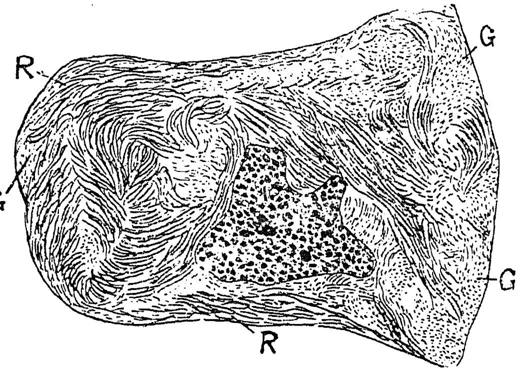
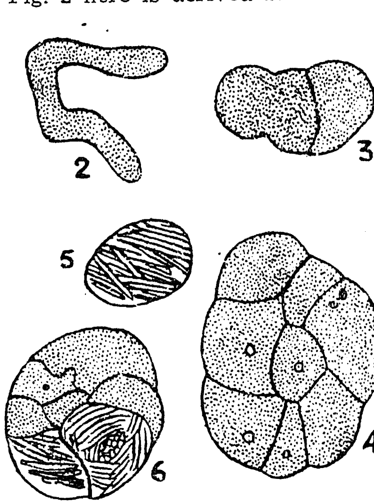


FIG. 1

longer bacterium produces B carotin which gives the small bacteriotome of the male insect its colour; the same pigment appears on its ventral surface and on its legs. In the female this provitamin is reduced to vitamin A and hence its smaller bacteriotome is pale and the dominating colour is that due to the pigment of the other bacterium which forms a green yellow pigment. This accounts for the absence of an orange colour in the small tumour of the female and on its ventral body surface. The male is rich in carotin and is more pigmented, the female is rich in vitamin A and is paler.

As investigated by Buchner and by Resühr the major tumour of *C. viridis* contains a species of what has been called cicadomyces by Sulc. Fig. 2 here is derived from Buchner and



FIGS. 2–6

represents a cell of such a mysterious microorganism. The same germ as seen infecting the egg is entirely different in shape; it becomes rounded as in Fig. 3; it may even form a ball of cell as in Fig. 4; all being derived from Buchner. In Figs. 2 and 3 there is no

nucleus or a vacuole, structures always present in yeasts and in fungus mycelium which should have justified the existence of a species of cicadomyces. In Fig. 4 on the contrary, nuclei-like bodies are vaguely indicated. Fig. 5 shows bacteria inclosed in a round body whose nature has not been indicated. Fig. 6 clearly shows a ball of cells the upper five of them being similar to Fig. 4 while the lower two cells in Fig. 6 resemble Fig. 5 which also contains bacteria. From a pure morphological standpoint Fig. 6 is an anomaly. What we actually see is that half of Fig. 6 conains bacteria while the rest is supposed to be cicadomyces; in fact Fig. 4 represents a ball of degenerate epithelial cells while Fig. 6 a similar group with two cells infected with bacteria. Fig. 1 represents protoplasmic piece of such cell attacked by germs and accounts for the absence of a nucleus or a vacuole.

When yeasts or bacteria, even those living in symbiosis, are smeared and the slide treated with pepsin and hydrochloric acid they resist digestion, while the so-called cicadomyces are all attacked as would be expected from tissue debris.

Summarising it may be said that attention has been drawn that males and females of *Cicadella viridis* differ in colour which also applies to their small tumours. The colour is due to bacteria of which there are two species and the different shades of colour in tumours and on insect bodies can be produced *in vitro* by varying the preponderance of one over the other germ. Cultures producing a green yellow pigment and B carotin pigment have been deposited[4] with the Lister Institute in England.

Biochemical Laboratory,
Research Institute,
Osmania University,
Hyderabad (Dn.),
February 8, 1947.

S. MAHDIHASSAN.

1. *Zeit. f. Morph. u. Ok.*, 1928, **4**, 136-8. 2. *Arch. Mikrobiol.*, 1938, **9**, 31. 3. *Curr. Sci.*, 1940, **9**, 495. 4. *Nature*, 1946, 13th July.

ALKALINE PHOSPHATASE IN ERYTHROCYTES

ALKALINE phosphatase has been shown to be present in serum and in various tissues such as bone, kidney, intestines, liver, etc. The determination of serum alkaline phosphatase has been utilized for diagnostic purposes, especially in rickets (Barnes and Carpenter, 1937). Recent work on experimental rickets by Dikshit and Patwardhan (1946) has raised some doubt regarding the current views about the osseous origin of the serum alkaline phosphatase. These authors could not find in rachitic dogs any correlation between the severity of rickets and the serum alkaline phosphatase values, an observation which they (1947, in press) subsequently confirmed in rachitic rats. Although Bodansky (1939) has suggested that the serum phosphatase represents the sum total of phosphatase contributed by different tissues, it was felt that a search for phosphatase in a tissue which is in close equilibrium with serum was warranted, and hence the possibility of the existence of an alkaline phosphatase in erythrocytes was investigated.

Roche and Bullinger (1939) reported the presence of an alkaline phosphatase in hæmolysed cells of the horse with an optimum activity at pH 9·2–9·5. Behrendt (1943) working with the hæmolysates of human blood failed to obtain a zone of activity at pH 9 although he found the enzyme active in the acid zone of pH 5. With the exception of Roche and Bullinger's report (*loc. cit.*) no mention is found in the literature concerning erythrocyte alkaline phosphatase.

The present authors have worked with the blood of albino rat, guinea-pig, sheep and man and they are convinced that the erythrocytes normally contain an alkaline phosphatase. The oxalated blood was centrifuged and washed with 0·9 per cent. NaCl solution four to five times on the centrifuge. Every time when the supernatant fluid was being removed the buff layer of leucocytes was also pipetted out. At the end of four or five such treatments practically no leucocytes must have remained in the packed cell mass. The cells were then hæmolysed by the addition of a mixture of alcohol and water (6:4). The proteins were precipitated by addition of chloroform and vigorous shaking. A water-clear upper layer was obtained which was carefully pipetted off after centrifuging the mixture. The enzyme was found dissolved in the aqueous layer. Sodium glycerophosphate at pH 9·3 (Veronal-acetate-HCl buffer) at 37° C. was used as substrate. Comparable experiments were carried out at pH 5·3. The results are given in Table I.

TABLE I

Erythrocytes	Mg. inorganic P liberated in 24 hours per 100 ml. of red blood cells	
	At pH 9·3	At pH 5·3
Albino rat ..	52	Nil
	62	Nil
	68	Nil
	60	Nil
Guinea pig ..	125	2·4
	69	1·6
Sheep ..	47	—
	31	Nil
	51	—
	63	14.6
Man ..	17	1·6
	23	—

It is concluded from the above experiments that in the four species of animals studied, the erythrocytes contain a phosphatase which is active at pH 9·3. It should be mentioned, however, that the enzyme is weak and has a relatively lower activity compared with that present in the plasma.

Further work on the problem is in progress

and will form the subject of a detailed communication elsewhere.

V. N. PATWARDHAN.
S. RANGANATHAN.

Nutrition Research Laboratories,
Indian Research Fund Association,
Coonoor, South India,
February 12, 1947.

1. Barnes, D. J., and Carpenter, M. D. *J. Pedsl.*, 1937, **10**, 596 2. Behrendt, H., *Proc. Soc. Exp. Biol. Med.*, 1943, **54**, 288. 3. Rodansky, *Ibid.*, 1939, **42**, 800. **4.** Dikshit, P. D. and Patwardhan, V. N., *Ind. Jour. Med. Res.*, 1946, **34**, Oct. 1946. 5. Roche, J. and Bullinger, E., *Enzymol.* 1939, **7**, 278, quoted from *Chem. Physol. Ab.*, 1940, **A3**, 349.

NIOBOTARTARIC ACID

It is known that freshly precipitated niobic and tantalic acids dissolve in solutions of organic acids like oxalic, tartaric, etc., resulting in the formation of complexes. The oxalate complexes have been investigated by Russ,[1] who also prepared a number of alkali nioboxalates. Edmister and Albritton[2] have furnished evidence for the formation of a complex of niobium with tartaric acid and also have reported a tartracolumbic acid; but its structure has not been confirmed and its salts have not been prepared. It was, therefore, proposed to study the complexes of niobium and tantalum with organic acids in greater detail.

Freshly precipitated niobic acid prepared from specially purified niobium pentoxide, was dissolved in hot aqueous tartaric acid. After filtering off undissolved niobic acid, the clear solution was concentrated and the niobotartaric acid crystallised with the addition of alcohol. The crystals were washed with dil. alcohol, dried and analysed. Niobium was determined by precipitating it from a solution of the sample and subsequent ignition and weighing as Nb_2O_5. Tartaric acid was estimated by the Goldenberg method.[3] The crystals were also titrated with standard alkali using phenolphthalene as indicator. The results of the analysis bear out the meta composition, *i.e.*, Nb_2O_5 : $2(C_4H_6O_6)$ for the niobotartaric acid formed. The sodium salt of this acid was also prepared by treating various sodiumniobates with tartaric acid. Further work on the complex acid and its structure is in progress by application of physical methods.

The author's thanks are due to Sir J. C. Ghosh and Dr. M. V. C. Sastri for kind encouragement.

General Chemistry Department,
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Bangalore, N. R. SRINIVASAN.
February 14, 1947.

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A NOTE ON THE OCCURRENCE OF THE MITE-*PARATETRANYCHUHUS INDICUS* H. ON JOWAR (*ANDROPOGON SORGHUM*) AND ITS PREDATORS IN MYSORE

In the issue of *Current Science*, No. 7, July 1946, pp. 186-87, Haroon Khan, M., and Bhatia, S. C., have recorded the occurrence of the mite *Paratetranychus indicus* H., and its effective predator *Scymnus gracialis* M., on sugarcane at Sakrand (Sind) which they came across while making a survey of crop pests there. They have described the severity of the mite pest and how it was checked by the predator.

Ramakrishna Iyer, T. V., has mentioned in his *Handbook of Economic Entomology for South India*, *Paratetranychus indicus* H., as one of the minor pests of *jola* in some areas; and *Scymnus coccivora* R., as a predator on *Pulvinara maxima* the Nim scale in Coimbatore. Lefroy has stated in *Indian Insect Life* that *Scymnus xerampelinus* M., and *Scymnus nubilans* M., are commonly found feeding on cotton aphis and cotton mealy bug. In Mysore, the occurrence of the mite and its predators have now been noted for the first time.

During 1946 (July–September) it was seen that the leaf blades of Jowar in certain parts of Mysore, Mandya and Chitaldroog Districts had turned blood-red. This condition was known by different names: *Chandramaru*, *Kumkumaroga*, *Rakthamari*, *Samberoga*, *Handiroga*, etc., in different villages.

On examination of the leaf blades the presence of a large number of mites (*Paratetranychus indicus* H.) was made out on every blade that had turned red. It was evident that the reddening of the leaf was due to the work of the mites. All stages of the mites—eggs, nymphs and adults, were located generally on the ventral surface of the leaf blades (the presence of the mite was also made out on the dorsal surface of some). Counts taken from a number of infected leaves selected at random showed an average of 182 per square inch. This figure is sufficient to indicate that the incidence was quite severe. In patches of severe infestation the entire stalk of the plant had become dry and pithy and the development of grains was arrested; earheads too had become dry; some of the grains had also turned reddish.

Two kinds of predator beetles, *Scymnus* sp., were found actively feeding on the mites. One was a tiny black oval shaped beetle and was perdominant in numbers. Both the larval grub and the adult were found to be feeding on this mite. The grub was found to actively chase the mite and when near dart at it to clutch it by its mandibles. It is transparent and full of warts and rows of short hairs on the tubercles. Pupae were seen on the leaf, attached by the caudal end. The adult beetle is uniformly black, the elytra being finely pubescent all over. The head region is tucked under, and cannot be made out and only the thoracic area is clearly seen.

The other beetle is bigger, brown in colour with a dark shade on the thorax and of the upper portion of the abdomen, the shade des-

cending narrowly in the centre of the elytra. The entire body is covered with fine pubescence. Both the grubs and the adults of these two Coccinellid beetles are effective predators on the mites.

I am grateful to Mr. B. Krishnamurti, Entomologist, for his kind suggestions and guidance in preparing this note.

Entomological Laboratory,
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Bangalore, M. PUTTA RUDRIAH.
January 9, 1947.

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A NEW RACE OF *PUCCINIA GRAMINIS TRITICI* AND TWO BIOTYPES OF RACE 42

DURING the course of the work on testing the reactions of wheat varieties and hybrids to black stem rust caused by *Puccinia graminis tritici* carried out at Mahabaleshwar, it was observed that certain varieties of wheat which were highly or moderately resistant to seven races of black rust found in India, *viz.*, 15, 21, 24, 34, 40, 42 and 75, in the seedling tests, developed large and healthy pustules when tested for mature plant resistance in the field. The presence of a new race or races in natural infection was suspected. Accordingly, isolations were made from some of these pustules, and the inoculum was multiplied separately on a susceptible variety of wheat grown in the glasshouse. The pathogenicity of the field isolates was tested on the wheats on which these were originally collected and ultimately pure cultures of three isolates were established.

These three isolates were tested on the differential wheat varieties and the reactions of the latter are described as under :—

(1) One of the isolates produced reactions on the differentials of an entirely different type from the reactions produced by any one of 189 races of black stem rust described by Stakman *et al.*[1] This isolate is, however, similar to race 119 of black rust except for its reactions on Kaphli, which is highly resistant (1-type infection) to race 119 but is moderately susceptible (3 to 4-type infection) to the new race under the conditions of light and temperature obtainable in the cold season at Mahabaleshwar. The reactions produced on the standard differentials by the new race of black rust, the material of which is being submitted to Dr. E. C. Stakman for comparative tests with race 119 under controlled conditions, are given in Table I.

TABLE I

Infection types produced by the new race and race 119 of P. graminis tritici *on differential wheat varieties*

Physiologic race	Reactions of differential varieties											
	Little Club	Marquis	Reliance	Kota	Arnautka	Mindum	Spelmar	Kubanka	Acme	Einkorn	Vernal	Khapli
New race	4	×	0;	0;	4	4	4	4	4	3–4	3–4	3–4
‡Race 119	4	×	0	0;	4	4	4	4	1–	3+	3+	1–

‡ Infection types as reported by Stakman *et al.*

(2) The other two isolates, when tested on the differentials, proved to be race 42 of black rust, but were found, on further tests on other wheat varieties, to be biotypes of this race. One of the biotypes, *viz.*, race 42A, produced type 4 infection on Khapli, whilst, under similar conditions of light and temperature at Mahabaleshwar, race 42, the material of which was originally obtained from the Rust Research Laboratory at Simla, produced type 3 infection. This biotype is more virulent on Khapli than race 42 or its other biotype, *viz.*, race 42B, and can easily be distinguished from the two latter when Khapli plants infected with these are placed side by side. Biotype 42B is, however, similar to race 42 in its reactions on Khapli but can easily be distinguished from the latter by its reactions on other wheats. Both the biotypes of race 42 were found in natural infection at Mahabaleshwar during 1944-45 and 1945-46 seasons. Comparative reactions of race 42 and its two biotypes on some wheat varieties are given in Table II.

TABLE II

Comparative reactions of some wheat varieties to race 42 and its biotypes

Wheat variety	Race 42	Biotype 42 A	Biotype 42 B
Khapli C. I. 4013 (Standard differential)	3	4	3
*Ex 3	2–3	3	4
*C. 6014	0;–2	2	3
*C. 14098	0;	2	4
*E. 220	0;	2	3+
**Hofed 1	0;	2	3+

* Wheat varieties received from the Wheat Specialist, C.P. and Berar.

** Wheat variety received from the Cereal Breeding, Station, Niphad, Bombay Province.

College of Agriculture, B. N. UPPAL.
Poona, V. P. GOKHALE.
December 13, 1946.

1. Stakman, E. C., M. N. Levine and W. Q. Loegering *Sci. Jour. Ser. Minn. Agric. Expt. Sta.*, 1944, Paper No. 2148.

THE EFFECT OF LONG PERIODS OF DARKNESS ON FLOWERING IN *SACCHARUM SPONTANEUM* SORAPARAI, 270

IN a previous note[1] a few photoperiodic treatments were suggested for inducing flowering and controlling the times of flowering in sugarcane varieties. One of these treatments, which enabled us to induce flowering in non-flowering wild form *Saccharum spontaneum* Burma, consisted in daily subjecting the potted top halves of this variety to 22 hours darkness for a period of two months prior to the commencement of the flowering season. Recently similar darkness treatments were tried on another type of *Saccharum spontaneum*, *viz.*, S.s. Soraparai, 270, and some very interesting results were obtained which seem worthy of mention.

Normal day light — Daily 22 hours darkness for a period of 15 days — Daily 22 hours darkness for a period of 30 days — Daily 22 hours darkness for a period of 45 days — Daily 22 hours darkness for a period of 60 days

FIG. Showing the effect of long periods of darkness on flowering in potted tops of the variety *Saccharum Spontaneum* Soraparai, 270

Top portions, removed from six months old plants of the variety S.s. Soraparai, 270, growing under field conditions were used for this study. These were planted upright in medium-sized pots, one in each pot, containing the ordinary garden-land soil. About a month after planting, *i.e.*, when the tops had just resumed growth, the pots were divided into five series, of five pots each, and were subjected to the following five treatments:—

(1) Normal daylight.

(2) Two-hour day only—from 12 noon to 2 p.m.—for a period of 15 days from 10th September to 10th October.

(3) Two-hours day only—from 12 noon to 2 p.m.—for a period of 30 days, from 10th September to 10th October.

(4) Two hours day only, for a period of 45 days from 10th September to 25th October.

(5) Two-hours day only, for a period of 60 days from 10th September to 10th November.

Results.—This variety came to flower on 30th November with the first treatment above (Fig. 1). It flowered on 10th December with the second treatment; on 2nd January with the third treatment; on 9th January with the fourth treatment and on 11th February with the last mentioned treatment, *i.e.*, showing a delay of about 75 days in the time of flowering as compared to the tops kept throughout under normal day-length conditions.

The intensity of flowering declined from 100 per cent. with the first treatment to 20 per cent. with the last treatment, *i.e.*, when subjected to two-hours day for a period of two months.

Thus, with the above treatments it has been possible to make available the arrows of the variety S.s. Soraparai, 270, for hybridisation work, throughout the flowering season.

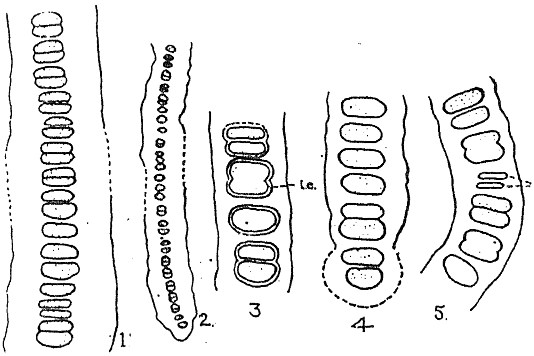
The author is indebted to Mr. N. L. Dutt for his keen interest and guidance during these investigations.

Imperial Sugarcane Breeding Station,
Coimbatore, N. D. YUSUF.
December 16, 1946.

1. Yusuf, N. D., and Dutt, N. L., *Curr. Sci.*, Nov. 1945.

OCCURRENCE OF *JOHANNESBAPTISTIA* IN THE ADAYAR RIVER, MADRAS

THE writer read with interest the paper[3] on *Johannesbaptistia pellucida* (Dickie) Taylor and Drouet[2] collected from a brackish water pool at Ennore, Madras. It is considered to have not been recorded from elsewhere in India. The present alga, however, was found in a huge collection of algæ made by the writer from the Adayar river, Madras. The Adayar alga agrees with the Ennore one in all details regarding structure and development (Text-Fig. 1-5) except in dimensions.



TEXT-FIGS. 1-5. *Johannesbaptistia pellucida* (Dickie) Taylor and Drouet.

Figs. 1 and 2. Portions of filaments with the diffluent margins of the sheath shown in dotted lines. Fig. 3. Portion of a filament showing the individual envelopes of the cells in a common mucilage. Fig. 4. End portion of a filament with a two-celled fragment (shown in dotted line) in the stage of dislodgement from the end. Fig. 5. Portion of a filament with two dead cells (*i.e.*, individual envelope; *d.c*, dead cells). Fig. 1, × 1,200; Fig 2, × 550; Figs. 3 5, × 1,650.

The dimensions of the filaments and cells of the Ennore alga were compared[3] with those given by Drouet[1] for *Johannesbaptistia pellucida* (Dickie) Taylor and Drouet (filament 8-23 μ broad and cells 4-17·5 μ broad and 2-6 μ long) and they come within the range of these dimensions. The dimensions of the present alga also accord with those given by Drouet.

		Ennore alga	Adayar alga
Long. fil.	..	400–2,500 μ	Up to 1,000 μ
Lat. fil.	..	7·9–9·2 (10·8) μ	11·4–15·2 (22·8) μ
Lat. cell.	..	3·9–5·2 μ.	5·8–8·3 (9·5) μ
Kong. cell.	..	2·6–3·9 μ	2·4–4·0 (4·8) μ
Crass vag.	..	—	2·6–6·4 μ

This alga is, therefore, referred to *Johannesbaptistia pellucida* (Dickie) Taylor and Drouet, though possessing broader cells and thicker sheath than those of the Ennore one.

The writer is grateful to Dr. F. W. Jane, PH.D., D.SC. (Lond.), and Professor V. Bharadwaja, M.SC., PH.D. (Lond.), F.L.S., for their very kind interest in the preparation of this note.

Teachers' College,
Saidapet,
Madras,
University College,
London,
November 25, 1946.

C. BHASHYAKARLA RAO.

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POLYELECTRONS

In an interesting article which appeared in the *Annals of the New York Academy of Sciences* (1946, 48, 219-38), Dr. Wheeler presents theoretical evidence for the existence of entities composed entirely of electrons and positrons together with a discussion of their properties. The simplest of these entities consists of one electron and one positron, bound together in a structure similar to that of the hydrogen atom. It has a life time of $1{\cdot}24 \times 10^{-10}$ sec., when the spins of the two particles are parallel, and a life several orders of magnitude greater, when the spins are anti-parallel. The next higher entity is composed of two positrons and one electron or of two electrons and one positron. It has a mean life of the order of 10^{-10} sec. The probability of production of a bi-electron by the interaction of an energetic gamma-ray with the field of force of an atomic nucleus is shown to be less than 10^{-6} of that for production of an electron-positron pair. The article contains a discussion of the similarities and distinct differences between polyelectrons and cosmic rays mesons.

REVIEWS

Principles of Fruit Preservation. By T. Nn Morris. (Chapman & Hall, Ltd., London), 1946. Pp. xiii + 198. Price 18*sh.*

This second edition of Mr. Morris's well-known book has appeared some thirteen years after the first. During this period, important advances have been made in the technology and underlying sciences of the fruit preservation industry. As such, one would have expected a considerable amount of revision of the earlier edition. This, however, has not been the case although a few sections have been rewritten and two new chapters added, one on candied fruits and the other on fruit juices. Thus, with very few exceptions, the references to literature cited date beyond ten years. Notable developments such as those relating to pectinic acids, steam-blanching before drying and freeze-drying, receive bare mention, sometimes only as footnotes, while comparatively older contributions are often discussed in detail as for example in the chapters on pectin-sugar-acid gels and spoilage of canned foods. It is disappointing to find no reference in a monograph of this kind to subjects such as gas storage and gas maturation, utilization and disposal of fruit wastes, or production of fruit wines and fruit vinegar. There is also the feeling that the chapters on discoloration in fruit products and vitamins in preserved fruits could have been brought closer to date with citations to recent sources. Again, some mention could well have been made to the use of firming agents, chemical preservatives and colours in various fruit processing operations.

As the title of the book indicates, the application of the fundamental sciences to the manufacturing processes concerned are given prominence but one wonders why several of the drying methods are described at great length. Perhaps a corresponding account of the mechanical systems of basic operations in canning, jam making, fruit juice bottling and quick freezing would have added considerably to the value of the book.

A feature of the book is the inclusion, in outline, of analytical methods for examination of processed fruits but these are neither adequate nor complete to be of value in the routine examination and chemical control of manufactured fruit products.

The foregoing criticisms must not be allowed to detract from the value of this publication. It is an outcome of much first-hand experience and careful thought has clearly been given to providing a simple, accurate and readable presentation, with many practical hints, of the principles of jam and jelly manufacture, fruit canning and fruit dehydration. As a working manual, it will certainly become as widely known and used as its earlier edition.

A. SREENIVASAN.

Controlled Atmospheres for the Heat Treatment of Metals. By Ivor Jenkins. (Chapman & Hall, London), 1946. Pp. 533. Price 50*sh.*

The book carries its hallmark of virtue on its first few pages in the shape of a foreword by no less a scientist than Dr. C. J. Smithells.

The author has, according to his preface, sought to bridge the gap between the theoretical and the practical aspects of the subject and to promote a more general recognition of the principles underlying a controlled atmosphere process. His efforts have met with unqualified success.

In the first edition of the book a brief survey is made of the historical development of controlled atmospheres in industry and this is followed by a discussion on the chemical equilibria of both inter-gas and gas-metal reactions.

Ammonia and its derivatives, hydrocarbon gases, charcoal gas and miscellaneous controlled atmospheres are dealt with—in successive chapters.

The middle section of the book is devoted mainly to the methods of removal of carbon dioxide, sulphur gases and water vapour from heat treatment atmosphere and concludes with a chapter on gas analysis.

In the third and last section attention is given to the industrial applications of controlled amospheres. The heat-treating of low carbon, high carbon and alloy steels is considered as well as the process of carburising and nitriding. The section concludes with a chapter dealing with the heat-treatment of non-ferrous alloys and metals.

It is impracticable to give in the space available a more detailed summary of the subject-matter contained in the 500 odd pages of this volume but a few of the reader's impressions may not be out of place.

One's sympathy goes out to the heat-treater of steel in his efforts to steer clear of the "Devil" of decarburisation and the "Deep blue sea" of oxidation. Inter-gas reactions, at high temperatures, between the various constituents of such a complicated mixture as town's gas—should provide congenial activity for readers with a taste for solving puzzles. A steel heat-treater has often the difficult task of utilising successfully an atmosphere which is both complex and variable in composition. These trouble raisers are avoided when ammonia or its derivatives are employed but the relatively high costs preclude their use in many commercial operations. Besides, precautions must be taken against the toxic qualities of ammonia and the explosive nature of a wide range of cracked ammonia-air mixtures.

The fact that the publishers have conformed to authorised economy standards seems to have had little detrimental effect on this attractively produced volume. Both text and the 268 figures (many of the latter being photographic reproductions) are as clear as one could wish.

Lastly, the author's style is simple and lucid, mathematics is kept in hand, the book contains many references and is well served with name and subject indexes.

The great expectations raised by the Dr. Smithell's foreword are amply realised and Dr. Jenkin's book should be found in the library of any undertaking which heat-treats metals and alloys.

FRANK ADCOCK.

The Methods of Plane Projective Geometry based on the Use of General Homogeneous Co-ordinates. By E. A. Maxwell. (Cambridge University Press), 1946. Pp. 230. Price 12*sh*. 6*d*. net.

The number of available books on the analytical geometry of conic sections is so large that one would naturally ask for himself whether it is worth while going through one more treatise on the subject. But the present book is really a welcome addition. Whether one agrees or not with the arrangement and the method of treatment adopted by the author, the book is interesting reading. The treatment of the chapters "One-One Algebraic Correspondence" and "Cross-Ratio and Harmonic Ranges" is very satisfactory from the algebraic point of view, and one will feel sorry that the same exhaustive treatment is not kept up, and that important subjects such as the invariants of two conics are not touched. The author, it is true, plainly says that his book "is written as a study of *methods* and not as a catalogue of theorems" and hopes "that a student reading it will have nothing to unlearn as he proceeds to apply these methods to study the geometry of figures in three dimensions or in higher space". But the treatment of the subject is so refreshing that we cannot help wishing for some more of these methods, and a more exhaustive treatment of many chapters would not have reduced the book to a catalogue of theorems. This is not a criticism against the book, but the reviewer feels that this is the best compliment that can be given for the book. In contrast with the above, the examples in the book are numerous and varied in character, and form a regular catalogue. Many of them are taken from various recent examinations, and hence provide welcome additions to the well-known stereotyped problems available in all books. The book can be strongly recommended to the student and to the teacher of the subject.

C. N. S.

Lymph. By Philip D. McMaster, Robert Chambers, Eliot A. Clark, Thomas F. Dougherty, Cecil K. Drinker, William E. Ehrich, Eugene M. Abraham White and B. W. Zweifach. (Published in the *Annals of the New York Academy of Sciences*, Vol. XLVI, Art. 8, pp. 679–882).

This volume contains an interesting series of original articles on the physiology of lymph. The first two articles contain an account of the circulation in the capillaries and related vessels and explain their actions in a more satisfactory manner than hitherto; the contractility of capillaries is brought into line with contractility elsewhere. Capillary permeability is then ably discussed by Landis; larger molecules can escape through the capillary walls more easily than smaller molecules if the equatorial diameter of the former is less than that of the latter. Then interesting experiments are described on lymph formation and their bearing on pathological problems elucidated. The functions of the lymphocytes and their relation to immunity is discussed. The researches of Drinker on extravascular protein are likely to have repercussions on the Starling hypothesis and provoke revision of our ideas on the osmotic functions plasma proteins.

INDERJIT SINGH

GEOMAGNETIC STORMS

Geomagnetic activity during the quarter ending December 1946 was far less marked than during the preceding three quarters. Some details of the geomagnetic disturbances recorded at Alibag Magnetic Observatory are given in the following table in which t_0, t represent time (I.S.T.) of commencement of the storm and its intense phase respectively and T the duration of the intense phase expressed in hours. The ranges in the three different elements (D, H and V) of the earth's magnetic field as recorded at Alibag Magnetic Observatory during the disturbances have also been given, D in minutes of arc, H and V in γ where $1\gamma = 10^{-5}$ gauss. The maximum k index (k_m, say) recorded during the disturbances have also been given.

Date	t_0	t	T	Range D	Range H	Range V	k_m	Nature of commencement
1946	h. m.	h. m.	hrs.	min.	γ	γ		
November 5–6	14 52	11 30 on Nov. 6	11½	3·1	138	27	5	Sudden
November 20–22	About 15 30	12 07	8	3·6	165	37	5	Gradual
November 24	9 16	15 25	6	3·4	215	24	6	Sudden

SCIENCE NOTES AND NEWS

FOURTH INTERNATIONAL CONGRESS FOR MICROBIOLOGY

The fourth International Congress for Microbiology will be held in Copenhagen, July 20|26, 1947, under the presidency of Th. Madsen. There will be nine sections: General Microbiology (*Convener*: K. A. Jensen), Medical and Veterinary Bacteriology (H. C. Bendixen), Viruses (J. Orskov), Serology and Immunology (M. Kristensen), Variation and Mutation in Micro-organisms (O. Winge), Plant Pathology and Mycology (N. F. Buchwald), Water and Soil Microbiology (E. Petersen), Dairy and Food Microbiology (E. Olsen), Alcoholic and Other Fermentations (H. Jorgensen). The Secretary, Dr. M. Bjorneboe, may be reached at the Kommunehospitalet, Copenhagen, Denmark.

INTERNATIONAL SOCIETY OF EXPERIMENTAL CYTOLOGY

Members of the Bureau of the International Society for Experimental Cytology met at Copenhagen, July 26|27, 1946. It was decided to reorganize the Society considerably (into an International Society for Cytology and Histology), to make it more permanent and to establish, if possible, a new scientific periodical. Dr. Harald Okkels (University of Copenhagen) and Dr. B. Fell are preparing new statutes, and also considering the relations with the Unions and UNESCO. Another conference, preliminary to the Stockholm Congress (*cf. infra*) will be held in Holland, Easter 1947.

SIXTH INTERNATIONAL CONGRESS ON EXPERIMENTAL CELL RESEARCH

The sixth International Congress on Experimental Cell Research will be held in Stockholm, July 20|26, 1947. The Congress will be organized by a Swedish working committee. J. Runnström, of WennerGrens Institute, will act as Chairman for the Conference, and T. Caspersson and H. Hyden, of the Karolinska Institute, as Secretaries. The Conference will include a series of symposia on problems in experimental cell research from physico-chemical, physiological and morphological aspects.

PACIFIC WAR MEMORIAL

The Pacific War Memorial, established in 1946, after the Pacific Science Conference (Headquarters at 70, Pine St., New York City) proposes to establish throughout the Pacific Ocean area strategically located field stations. These field stations will correspond with many points where Americans died fighting for freedom. In addition the Memorial will initiate a plan for the creation of War Memorial National Parks and Reserves where samples of the unique wild life of the region may be preserved in its natural habitat for the future. The purpose of the field stations is to serve as bases for original exploration, collecting and research in the natural and physical sciences. These stations will furnish equipment and laboratory facilities for visiting scientists as well as a permanent research staff.

CENTRAALBUREAU VOOR SCHIMMELCULTURES

The Centraalbureau voor Schimmelcultures, at Baarn, Neth. (Dir. Joh. Westerdijk), issued its latest catalogue, a 140 page list of some 7,000 fungi and yeasts, in 1943. Copies of this and further information may be obtained from the Bureau which has not been damaged to any extent during the war years.

A MYCOLOGICAL AND PLANT PATHOLOGICAL SOCIETY FOR INDIA

Drs. J. F. Dastur and B. B. Mundkur have sent us the following circular:

"Several Mycologists and Plant Pathologists have from time to time expressed a desire that a Society of Plant Pathologists and Mycologists for India be formed, following the lines of the Indian Entomological Society and the Society of Indian Plant Breeders and Geneticists. As the number of workers on mycological and plant pathological problems is steadily increasing in India in the Research Institutes, Universities and Colleges of Science and of Agriculture, it has seemed desirable to start a move for founding such a Society.

The primary objective of such a Society would be to advance the study of Mycology and Plant Pathology in India and to publish the work done by Indian Mycologists and Plant Pathologists by issuing a Journal which would include summaries of important papers published abroad, for though plant pathological and applied mycological literature is adequately reviewed in the *Review of Applied Mycology*, articles of purely mycological interest are not abstracted in that Journal. The Society will also strive to be the adviser of the Central and Provincial and State Governments in mycological and plant pathological matters, just as the American Phytopathological Society is doing in the United States of America.

If a fairly good response is received as a result of this appeal, it is proposed to concert measures for founding such a Society during the forthcoming meeting of the Plant Pathological Committee of the Indian Council of Agricultural Research when distinguished Mycologists and Plant Pathologists are expected to be at New Delhi, by calling a meeting for the purpose."

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CURRENT SCIENCE

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NEW PATHS IN CRYSTAL PHYSICS

THE vast majority of actual solids are crystalline in their ultimate structure. Hence arises the theoretical and practical importance of the subject of crystal physics, and the need for a correct understanding of its fundamental principles. The outstanding feature of the crystalline state of matter is the three-dimensional periodicity of the structure of a crystal, which consists of a great number of similar, similarly situated and oriented groups of atoms, thereby securing for it the fundamental property of physical homogeneity. The size of the individual units or lattice cells of the structure is, in general, of extreme smallness in comparison with the overall dimensions of a macroscopic crystal. It follows as a consequence that the characteristic physical properties of a crystal are determined by its lattice structure and that the form or extension of its exterior boundary is a matter of complete indifference, so long as the crystal is of macroscopic dimensions. These considerations are so little controversial that the need for stressing them here requires explanation. The mathematical physicists of the nineteenth century were so largely concerned with the so-called "boundary value problems" that the tendency has grown up of regarding every physical question needing theoretical treatment as a "boundary value problem" and trying to set up "boundary conditions" for its solution irrespective of whether such considerations are relevant to the problem or not. The subject of crystal physics has in particular suffered from this tradition inherited from an earlier epoch, so much so that theories resting on it continue to be believed in despite their being in total contradiction with the experimental facts. It is proposed in this report to consider a fundamental topic in crystal physics in which such a situation exists, *viz.*, the nature of the vibration spectrum of a crystal lattice. A similar situation has also arisen in a related subject of scarcely less importance, namely, the electronic energy levels of a crystal lattice, but this will be dealt with on a later occasion.

The Atomic Vibration Spectrum

The frequencies of vibration of the atoms in a crystal about their positions of equilibrium in the space lattice lie in the infra-red and may be made accessible to study by various spectroscopic methods. It is evident that the frequency spectrum of the atomic vibrations thus made observable is a characteristic physical property of the crystal. The problem of ascertaining it is in many respects similar to that of finding the vibration spectrum of a polyatomic molecule and can be handled by very similar methods. For this purpose, we consider the equations of motion of the atoms contained in the unit cell of the crystal lattice. If there are p atoms in the unit cell, there would be $3p$ equations of motion to be solved. The equations would contain the displacements of the atoms included in the unit cell under consideration, as also the displacements of the atoms in the surrounding cells which influence the motion of the former. The equations of motion of the atoms included in these other cells must also be simultaneously satisfied. The relations which must subsist between the various atomic displacements for this to be possible are indicated by the following considerations. Firstly, we remark that as a consequence of the translational symmetry of the crystal, a normal mode of vibration must remain as such when the crystal lattice is given a unit displacement along any one of the three axes of the space lattice. Secondly, we recall the fundamental property of a normal mode that all the particles of the system vibrate with the same frequency and pass simultaneously through their positions of equilibrium, so that the phases of vibration are all either the same or opposite. Combining these two propositions, it follows that the amplitudes of vibration of equivalent atoms remain the same, while the phases either all remain the same or else are all reversed as the result of the unit translation. In other words, in a normal mode, equivalent atoms have the same amplitudes, and either all the same phase or alternately opposite phases of vibration in successive cells along each axis of the lattice. Thus two alternative possibilities arise in respect of each of the three axes, and since they are independent, we have $2 \times 2 \times 2$ or 8 distinct possibilities to be considered. For each of these 8 possibilities we have $3p$ equations of motion involving only $3p$ unknown co-ordinates, and hence capable of being completely solved. Thus in all we have $8 \times 3p$ or $24p$ solutions, which after excluding the three simple translations of the unit cell, give us $(24p - 3)$ normal modes of vibration of the crystal lattice.

The foregoing considerations are, of course, strictly classical, but their validity is not altered when we consider the problem in the light of the general principles of the quantum theory. For this purpose, we may take the case of a crystal the unit cells of which contain each one molecule composed of p atoms linked together. In the absence of interactions, the $3p$ degrees of freedom of the atoms in the cell appear as the 3 translations and $(3p - 3)$ quantised rotations and vibrations of the molecule. Neighbouring molecules having the same frequency would have the same energy and therefore the same amplitude of vibration, but their phases would be uncorrelated. The interactions would, however, result in particular phase relations being set up and also influence the common frequency of vibration in a manner determined by the phase relations that arise. A common frequency of vibration involves a homogeneous set of phase relations throughout the assembly, and on the basis that the phases are either the same or opposite, there are just 8 possible ways in which they could be arranged. Accordingly, each mode of vibration of the individual molecule would split up into 8 distinct modes of vibration of the assembly. Assuming that the interactions are strong enough to prevent free rotations of the molecules, we thus obtain $(24p - 3)$ distinct quantised modes of vibration of the assembly. Each of these, of course, must be regarded as being very highly degenerate.

Remarks on Some Earlier Theories

The result thus emerges that the vibration spectrum of a crystal lattice is a discrete line spectrum exhibiting a finite set of monochromatic frequencies. The number of discrete frequencies would be further diminished if the crystal has additional symmetry properties, since several of the distinct normal modes would then have identical frequencies. We may mention a few cases by way of example. A simple face-centred or body-centred cubic lattice would have 4 distinct frequencies of atomic vibration, the diamond lattice would have 8 distinct frequencies and the rock-salt lattice would have 9 such. The modes of vibration in such simple cases can be fully described on the basis of symmetry considerations alone. More generally, however, a detailed investigation would be necessary to find the exact nature of the individual normal modes.

The whole of the present generation of physicists has been brought up to believe in the notion first put forward by Debye in 1912 that the thermal energy of a crystalline solid may be identified with the energy of vibrations of the elastic solid type occurring in it. This idea leads to the result that the frequency spectrum of the atomic vibrations in the crystal is a continuous one, in striking contrast with the conclusions reached above, which indicate that even for the simplest crystals it is a discrete line spectrum of monochromatic frequencies. The reasons for this discrepancy are not far to seek and are, in fact, to be found in the essential illegitimacy of Debye's assumptions. The fact that the specific heat of every crystal attains the value given by the law of atomic heats when its temperature is sufficiently raised, as well as the actual course of the curve by which this value is reached clearly show that we are concerned with the vibrations of the individual atoms in the crystal and that the problem is therefore essentially one of particle dynamics and not one of wave propagation in a continuous solid. Further, the frequencies of vibration which determine the course of the specific heat curve lie, for the most part, well beyond the range where the theory of wave-propagation in an elastic solid can with any show of justification be regarded as applicable. This is readily seen from Debye's own calculations which indicate that by far the largest proportion of his "waves" have lengths of the same order of magnitude as the lattice spacings of the crystal. The invalidity of the Debye theory becomes clearest when we examine the question of "counting" up the modes of vibration of the system. "Waves" as such are not enumerable, since they may be assigned any arbitrary wavelength and consequently arbitrary frequency. Hence, a count of them is meaningless unless it can be shown that only certain discrete wavelengths with correspondingly defined frequencies are allowed and that all the others are excluded by the very nature of the case, thereby enabling the vibrations to be identified with the normal modes of the system which are enumerable according to Lagrange's fundamental theorem. It is not possible to escape this difficulty by regarding the waves as equivalent to "stationary vibrations" in an elastic solid continuum, since we are principally concerned with vibrations of such high frequency that the lattice structure of the crystal is of the very essence of the problem.

Difficulties of the same kind arise in an even more acute form when we proceed to examine the logical foundations of the theory of lattice vibrations in crystals developed by Max Born and his school. The whole framework of the Born theory rests upon the idea that, since the "boundary conditions" cannot be specified, something should be found which could replace them and by which the fundamental difficulty may be overcome of enumerating the "waves" with which the vibrations of the system are identified. The postulate of the cyclic lattice is introduced in the theory with this object. It provides the requisite number of "waves" whose lengths determine both the so-called acoustic and optical oscillations of the lattice. As in the Debye theory, the "waves" thus chosen are most numerous in the region of wavelengths nearly comparable with the lattice spacings of the crystal, with the result that both the "acoustic" and "optical" vibrations are spread out into "branches" extending over a wide range of frequencies as is indicated by the calculations made by the Born school for the few cases in which the ideas have actually been worked out.

The artificial character of the cyclic postulate is very obvious, and it is sufficient to point out that it does not achieve the purpose for which it has been introduced. Born's own equations show that, if the vibrations of the medium are regarded as waves, then the wavelengths can be chosen quite arbitrarily. Unless therefore it can be shown that the particular choice made is uniquely demanded by physical reasoning which is necessary if the resulting motion is to be identified with normal vibrations in the Lagrangian sense the frequency spectrum determined by such arbitrary choice of wavelengths can have no possible physical meaning or significance. Indeed, it is plain that the "waves" of the Born theory have no claim whatever to be regarded as the normal modes of vibration of the crystal lattice.

Experimental Configuration of the New Ideas

The theoretical result that the vibration spectrum of a crystal lattice is a discrete or line spectrum of monochromatic frequencies is naturally subject to the restrictions implied in its derivation. The theory is based on a consideration of small oscillations under harmonic forces in an ideal lattice. Departures from perfect monochromatism of the vibrations are naturally to be expected when these simplifying restrictions are removed, *viz.*, when we consider oscillations of finite amplitudes, an-

harmonic forces and crystal lattices which are imperfect or which are disturbed appreciably by thermal agitation. These may be minimised by working under appropriate conditions, and the most decisive results are naturally those obtained with crystals most nearly approaching ideality and held at a sufficiently low temperature. Various methods of investigation are available, *viz.*, the spectra of light-scattering, luminiscence and absorption in crystals and a vast array of experimental evidence gathered during the last two decades by these and other methods of exact spectroscopic research is on record, to which the interested reader may be referred.

Of special interest are the recent investigations of Dr. R. S. Krishnan (*Nature*, 159, 1947, p. 60) on the scattering of light in diamond observed under high resolving powers which give a direct objective demonstration of the monochromatic character of the atomic vibrations in that crystal and simultaneously furnish an experimental refutation of the ideas underlying the older theories. Analogous studies with various other crystals, *viz.*, rock-salt, ammonium chloride, ammonium bromide, corundum, topaz, etc., have also been carried out by Dr. R. S. Krishnan and the results obtained by him are particularly significant in view of the fact that they have been carried out under critical experimental conditions, *viz.*, using the highest possible spectroscopic resolving powers and also working with the crystals held at a series of temperatures down to that of liquid air. The detailed results of these investigations will shortly be published as a Symposium on the Vibration Spectra of Crystal Lattices by the Indian Academy of Sciences, which will also include a complete review and theoretical discussion of the entire body of spectroscopic evidence available up to date from the most exact investigations on the behaviour of crystals made by investigators in various countries. It emerges unequivocally from these studies that the theories which suggest that the atomic vibrations in crystal lattices give a continuous spectrum are in clear contradiction with the experimental facts and are therefore wholly unsustainable.

C. V. RAMAN.

THE SHRI RAM INSTITUTE FOR INDUSTRIAL RESEARCH, DELHI

THE laying of the foundation-stone of the Shri Ram Institute for Industrial Research constitutes a landmark in the development of Industrial Research in this country. In the inspiring words of Sir Shri Ram, the founder himself, "Our industries have so far been very much unmindful of the needs for industrial research. Expenditure on industrial research which our industries and the Government have so far done is negligible compared to what has been done in other industrially advanced countries, with the result that these countries have made great progress both in technique and organisation of industries and our country has lagged behind. Thus the establishment, all over the country, of a number of industrial research institutes with roots deep in applied and fundamental research is imperative. The inspiring example of the contribution of the Mellon Institute of Industrial Research at Pittsburgh in the United States of America should be the guiding star for all our efforts." The same idea has been further emphasised by Sir Maurice Gwyer who prefaces the prospectus of the Institute with a Foreword, writes, "The imperative need for research on the scientific side into the fundamental problems of industry is now generally recognised. The Universities and Technological Institutes have their own functions. The Universities, apart from the instructions which they provide, are or should be, concerned with the problems of what is sometimes called pure science; the Technological Institutes with the broad general principles of technology, which are themselves based on the researches of pure science. An industrial Research Institute is concerned rather with the application of the principles of pure science and of technology to the problems of industry as they arise. Many of these problems do not admit of solution without further research into the fundamental principles both of pure science and of technology; and hence the scope of an Industrial Research Institute is at once both broader and narrower than that of Universities and Institutes of Technology. No industry can at the present day afford to neglect scientific research into its own problems; nor can it in any country be content to rely upon research work done elsewhere."

India is on the threshold of a great industrial revolution; post-war plans on ambitious and gigantic scale but in harmony with the great potentialities of this country, have been drawn up. The men and the means of accomplishing the tasks facing the country have got to be provided. Sir Shri Ram Institute, which owes its inception to the patriotic munificence and the far-seeing vision of Lalaji is expected to play its part in a planned and rationalised industrial development of India.

THE NATIONAL PHYSICAL LABORATORY OF INDIA, DELHI*

By Sir S. S. Bhatnagar

(Director, Scientific and Industrial Research)

The Genesis

In the year 1941, the Director of Scientific and Industrial Research represented to the then Commerce Member, Sir Ramaswamy Mudaliar, who was also the founder of the Council of Scientific and Industrial Research, that the prime essential for India's industrial development was a Central Research Laboratory, separating as it developed into a National Chemical and a National Physical Laboratory. Already the Government had provided us with a laboratory at the Government Test House in Calcutta to make a beginning in the matter of organising scientific and industrial research in the country to meet national and defence needs necessitated by the war. I proposed in a note both an expansion of the Government Test House and the creation of new laboratories in Calcutta, Delhi or other places climatically more suited. These proposals were still under examination when the entry of Japan into the war changed the situation completely and it became clear that any expansion of activity at Calcutta was out of the question, since Calcutta was obviously vulnerable to air attack. So, it was decided to remove the laboratories of the Director of Scientific and Industrial Research to Delhi and continue the work of the Board at the headquarters of the Government.

The idea of establishing a twin-set of laboratories, the National Physical Laboratory and the National Chemical Laboratory, was accepted in the beginning of 1943 by the then formed Council of Scientific and Industrial Research. Soon after, the idea was widened in scope and the Council approached the Government of India for the grant of a crore of rupees for the post-war establishment of five National Laboratories, the three additional ones being, a National Metallurgical Laboratory, a Central Glass and Ceramic Research Institute and a Fuel Research Institute. Planning Committees consisting of some of the best available scientific and technical talent in the country were set up to prepare broad plans for the work, functions and organisation of each of these laboratories.

It is necessary to stress here the nature of the National Laboratories. These laboratories do not intend to supplant but to supplement the work of individual or collective industrial concerns in respect of research. They undertake work of the kind that does not come ordinarily under the scope of industries. Since they are able to command resources wider than the industries can, the laboratories can employ more talent and try alternative approaches to problems simultaneously. Problems which bear wider social aspects than an industry could be concerned which become subjects of state scientific research. Moreover, the advice that state research can give will be non-partisan. Industry can hardly undertake work of a purely exploratory nature. So the function of these laboratories is both complementary and independent.

The Planning Committee

The Planning Committee for the National Physical Laboratory consisted of Sir Ghulam Mohammad as Chairman and as members, Prof. M. N. Saha, Dr. Nazir Ahmad, Sir K. S. Krishnan, Principal G. R. Paranjpe, Dr. H. J. Bhabha, Dr. Wali Mohammad, Dr. D. M. Bose, Dr. Rafi Mohammad Chaudhry and Mr. N. N. Sen Gupta and myself. Besides these members, the Council obtained the services of Dr. K. N. Mathur from the University of Lucknow as Assistant Director for planning and as Secretary to the Committee. Following the usual procedure of the Council's Planning Committee Reports, the National Physical Laboratory Report was first drawn up in a tentative form and was widely circulated, to invite comments and suggestions, both in India and abroad. The response the Committee received could, perhaps, be taken as an index of the general interest in the Laboratory. Besides a volume of comments and suggestions from individual scientists, scientific institutions and Government Departments in India, we had the benefit of the advice of the President of the California Institute of Technology, Prof. Robert A. Millikan, the Director of the National Bureau of Standards, Dr. Lyman Briggs and the Director of the National Physical Laboratory (of England), Sir Charles Darwin. In England, the National Physical Laboratory, situated in the picturesque surroundings of the Bushy Park has established an envied reputation for itself. Its tests and certificates are taken as the hall-mark of the highest precision and accuracy which scientific knowledge and human ingenuity can attain. As members of the Scientific Mission which visited U.K. and U.S.A. in 1945 some of us had the privilege of a free discussion with Sir Charles Darwin and members of his staff on the tentative proposals for the National Physical Laboratory. This discussion and the suggestions received, enabled the Planning Committee to finalise their report which was published early this year and was accepted by the Governing Body of the Council.

Organisation and Function of the National Physical Laboratory

In the main, the Laboratory's foremost function will be the maintenance of fundamental and derived standards, and the undertaking of research with a view to achieve greater and greater accuracy in the measurement of these standards. At present there is no well-equipped laboratory in India which can undertake standards work. One or two laboratories in

* Edited extracts from the Address delivered by Sir S. S. Bhatnagar, Kt., O.B.E., D.Sc., F.R.S., on the occassion of the Foundation Stone Laying Ceremony of the National Physical Laboratory during the first week of January 1947.

India possess yard and metre bars which were at one time standardised by the National Physical Laboratory at Teddington. The Mint at Bombay have in their possession certain standard weights certified by the National Physical Laboratory of England. But in neither case any systematic organisation exists to undertake regularly inter-comparisons between their standards and those of the other countries, which is the accepted method of all standards laboratories. Besides the fundamental standards of length, mass and time, there is a large number of derived standards like volume which comes in so much in chemical glassware, and in gallon measures of liquids; the various electrical units against which all the electrical measuring work of the scientists, the electrical industry and the electric supply companies is standardized; density measurements, which are of use not only to the scientists but also to the layman. The Lactometer interests the housewife as a handy weapon in her constant travail against the quantity of water in domestic milk supply. Perhaps, one of the biggest contributions which the National Physical Laboratory in England made under the able direction of Sir Charles Darwin was their organisation for testing gauges for the industry during the war time. We are on the threshold of a great industrial development in the country in which the development of engineering industry is expected to play a very great part. No precision work in engineering can be done without an adequate supply of calibrated gauges, and some organised laboratory where these gauges could be checked and rechecked periodically since gauges wear off with use. This point may be better appreciated if I were to say that in the fittings of high grade automobiles and aero-engines an accuracy better than one part in ten thousand is usually required in individual parts. At the National Physical Laboratory at Teddington, gauges are tested to an accuracy of better than one part in a million. In the calibration of the standard weights they have reached an accuracy of one part in ten million through the use of a special type of balance and accurate control of outer conditions.

Nine Divisions

The work of the laboratory in India will be carried on through the following nine Divisions:—

(1) Weights and Measures.
(2) Applied Mechanics and Materials.
(3) Heat and Power.
(4) Optics.
(5) Electricity.
(6) Electronics and Sound.
(7) Building and Housing Research.
(8) Hydraulic Research.
(9) Analytical Chemistry.

Each of these divisions will be under an Assistant Director, who will have under him scientific assistants besides other laboratory staff.

Liaison with Industry

Apart from the work of standardisation the laboratory will be called upon to undertake considerable amount of research work which is expected to go a long way towards developing Industry in this country. Physical science is taking long and fast strides. New discoveries in the fundamental sciences are opening up vast possibilities of industrial application both by way of improving old processes and by introducing new ones. The National Physical Laboratory will be concerned with maintaining constant research work to fulfil this purpose. For the same reason they will maintain a close liaison with Industry. Investigation of raw materials of the country with a view to adopt them to the requirements of the industry will be a correlative work which the laboratory will undertake.

Industrial Standardisation

A very important aspect to which sufficient attention has not been given in this country is that of industrial standardisation. It may be recalled that the Government of India recently set up a body known as Indian Standards Institution, which will undertake industrial standardization in India on somewhat the same lines as the British Standards Institution does in the U.K. The work of the B.S.I. is carried on mainly through the active assistance of scientific laboratories. The National Physical Laboratory in England has contributed not a little towards the success of industrial standardisation there in all branches which lie within the scope of their work. The Council of Scientific and Industrial Research have been associated intimately with the formation of the Indian Standards Institution and Dr. Mathur recently represented them at the British Commonwealth Standards Conference and the International Conference on Standardisation, held in London in October last. At both these conferences, measures for a better co-ordination of industrial standardisation were discussed. If India is to play her role as a great nation she has to take an active part in scientific and technological work of an international character quite as much as in the international political sphere. Speaking from experience, I can say without hesitation that the amount of unanimity which the scientists are able to achieve is quite unimaginable amongst politicians. The National Physical Laboratory Planning Committee has rightly laid great stress on the point that the Laboratory shall in all possible ways assist Industrial Standardisation.

Fundamental *vs.* Applied Research

The subject of fundamental *versus* applied research has been recently heard in many quarters. In the minds of those qualified to speak research can hardly be divided into water-tight compartments and such division is a scholastic distinction which ignores how scientific research develops. What is fundamental to-day, may become very much of applied research in a very short while. The electrical dynamo was as much the result of fundamental work on the nature of electricity as the development of atomic energy the result of abstract calculations of the nuclear physicists. Both the theoretical and practical aspects of science have thus progressed by their intimate interplay. An artificial separation is neither theoretically sound nor practically workable and if enforced renders theory arid and practice a petrified routine. *It is by the inter-pollination*

of thought and work that the most fruitful result emerges. I am glad to state the Council of Scientific and Industrial Research has been keenly alive to this and has given as much encouragement to research of a purely academic type as to applied or utilitarian work. As instances, the Council's grant to Tata Institute of Fundamental Research, the Palit Research Laboratory of Calcutta, the Bose Research Laboratory, and the several research schemes in operation under the auspices of the Council bearing on fundamental aspects of sciences may be mentioned. The Planning Committee of the National Physical Laboratory have also stressed the importance of encouragement to both these aspects of research.

Fundamental Research To-day—An Organised Industry

One aspect of fundamental research work which can hardly be neglected in India is that which requires specialised large-scale laboratories. During recent years, and particularly during the last world war, organisation of scientific work has undergone vast changes. Not only does some of the present type of work require large-scale specialised organisations well outside the scope of university work but also expenditure of money running into millions which could only be justified if diversified, co-ordinated and regulated application and professional continuity of work are guaranteed. This is not usually possible in the universities where teaching and research necessarily go hand in hand and are essentially preparatory. Research work there, is bound to be scrappy, discontinuous, and unco-ordinated. I may be permitted to quote here from a recent article by Dr. Lee A. Dubridge who is now President of the California Institute of Technology and who during the war was Director of the Radiation Laboratory at the Massachusetts Institute of Technology which had such a lot to do with the conduct of atomic energy development in the U.S.A. Discussing the importance of large research laboratories, Dr. Dubridge says "... it should be clear that independent laboratories will have as their major facilities only those very large installations which, as far as can be foreseen, are beyond what a single university could contemplate operating—or which, because of shortage of material or funds, not more than one or two universities in any area could have. So, I, for one, look forward with keen interest to a great new experiment in physical research. Those who long for the old days with lone worker in the basement room with his wax and string and glass-blowing torch can have them. I believe that the essential spirit of the old days—freedom of enquiry, time for thought—can be obtained even in the pressure of great new physical and organizational techniques." In short, fundamental research is soon becoming a huge organised industry in itself.

Location of the Laboratory

The question of location of the National Physical Laboratory was thrashed out threadbare and the Committee made out an overwhelming case in favour of locating the Laboratory at the headquarters of the Central Government. In any new constitution the importance of contact between science and state will even be greater. Delhi, besides being the seat of a young and hence very virile university, is in addition the headquarters of a number of scientific departments of the Government of India like the Meteorological Department, the Agricultural Department, the Medical Department, the Royal Indian Air Force, the Scientific Section of the G.H.Q., the All-India Radio, the Railway Board and others. We are particularly fortunate in the present site as we are close neighbours of an Institution which has played no inconsiderable part in India's agricultural development—I mean the Agricultural Research Institute right opposite us. The Institute has one of the best libraries on the biological sciences, and between the National Physical Laboratory and the Institute, we shall have the most complete scientific library in India which we hope will form the nucleus of a Central Information Service for all the scientific workers in India.

These are days of decision for India and if she is to take, as she must, her rightful and honoured place among the nations of the world she must grow strong and great industrially. In this great and exacting venture the role of the national laboratories will be vital and the people of our country, whose mind and face are already turned towards science in industry and society, will, I am sure, take great interest in the work of the laboratories and extend their unflagging help in their development.

APPLIED ENTOMOLOGY, ITS PAST AND FUTURE IN INDIA*

DR. BHALERAO has been recognized as one of the authorities on Indian Helminthology, and as one who has devoted himself to the subject for the past twenty years, he is in the best position to correlate all our accumulated knowledge of Helminth parasites. He has himself contributed to the elucidation of the life-histories of a number of helminths, either directly or indirectly affecting man and has, in the address, listed all the parasites that have been reported from time to time in this country. Working in one of the premier Research Institutes of India (Imperial Institute of Veterinary Research), it is natural that the parasites of domestic animals get their full attention in his address and a long and comprehensive list is presented of trematodes, cestodes and nematodes occurring in animals that are associated with man's life in India. In a necessarily brief address such as this, it is naturally impossible to expect comprehensive accounts of the life-history of each species. In fact, in quite a number of cases, the life-history is unknown. That is where Dr. Bhalerao's address is a help, in drawing attention to the vast amount of work that is still to be done, and the large number of gaps in our knowledge still to be bridged. Brief references are made in the case of each parasite, to its host, to the disease it causes, and also in such cases where the life-history is fully known, to the remedies.

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* Summary of Dr. G. D. Bhalerao's Presidential Address to the Section of Zoology and Entomology, Indian Science Congress, Delhi, 1947.

THE YELLOWING OF BLEACHED JUTE

By P. B. SARKAR, H. CHATTERJEE, A. K. MAZUMDAR AND C. R. NODDER

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THERE is good reason to believe that pure, undegraded cellulose (not holocelluloses) if stored in the dark in a vacuum at low temperatures would retain its whiteness almost indefinitely. At the other extreme, bleached cellulosic fibres containing a high proportion of non-cellulosic impurities are known to become brownish or yellowish fairly quickly during ordinary storage. Exposure to light, as in the case of partly bleached jute, may accelerate the process. Storage at a high temperature also hastens the discoloration. There are various intermediate conditions of purity and storage and the part played by all the factors cannot be said to be well understood for vegetable fibres in general, though in the case of cotton and linen a good deal of information is available. The present preliminary note is concerned with the yellowing of bleached jute on storage, particularly of jute bleached by means of sodium chlorite without thorough scouring.

In the case of cotton and linen the presence of degraded cellulose (oxycellulose or hydrocellulose) is known to cause a yellowish discoloration in storage. Moreover, it is known that linen which has not been well "bottomed" (well scoured with boiling alkaline solutions) is liable to lose its whiteness in storage. Here the hemicelluloses (of which flax, like jute, contains some 20 per cent.) remain in the bleached goods. The role of naturally occurring fats and waxes is less well-known, though experiments with cotton have shown that the effect of residual wax is negligible. The effect of so-called "chloramines" has not been quite clearly separated from other factors, but it is certain that partly bleached linen which has not been antichlored and contains substances, whatever they may be, which liberate iodine from acidified potassium iodide is liable to rather rapid yellowing.

It is obviously impossible to ascribe the yellowing of bleached vegetable fibres in general to any single cause. Fibres vary greatly in composition, for example, in cellulose content, lignin content, hemicellulose content, and the nature of the bleaching process is also subject to great variation, as in thoroughness of scouring, the chemical used for the oxidative treatment and its conditions of use (strength of liquor, reaction, duration, temperature), use of antichlors, thoroughness of washing and so on. Some of the views that have been held are illustrated by the following examples. Kuchinka,[1] studying the linen bleaching process, held the oxidation products of cellulose to be the cause of yellowing. A similar view is taken in a patent[2] of the Mathieson Alkali Works, it being claimed that the use of sodium chlorite ("Textone") produces less oxycellulose than the use of hypochlorites and gives a more permanent white. Ridge and Little[3] suggest that the complete removal of lignin is necessary in order to obtain a white that does not yellow on exposure to light. Giertz,[4] however, could not trace the discoloration of bleached woodpulps to any degradation product of lignin and considered that yellowing was due to the decomposition products of hemicelluloses. Elgin,[5] in describing a patent, holds the natural pigments of lignified fibres to be responsible for yellowing and claims that their removal by organic solvents permits a brilliant permanent white to be obtained by bleaching with hydrogen peroxide, indicating that the process is applicable to jute.

Jute bleached by a process which includes thorough scouring with alkalies and careful treatment with hypochlorites will show a good, permanent white, but the natural cement which joins together the short ultimate fibres is removed in such treatments and the fibre has little or no strength, especially when wet, resembling in this respect papers made from wood-pulp. The problem is, therefore, to discover a means of removing the substances which are responsible for yellowing without removing the intercellular cement; any process that involves thorough scouring, or even mild hot alkaline treatments, must be avoided if good wet strength is to be obtained.

The observations to be described do not solve the problem, and the production of a really full permanent white on jute, if not impossible, is clearly a matter of great difficulty. Some light is, however, thrown on the matter and the result obtained when bleached jute was stored under alcohol seems to be of considerable importance in suggesting lines of attack.

The after-yellowing of jute bleached, or delignified, without scouring, by means of sodium chlorite has been examined in the course of our work during the past two or three years and the following observations are now recorded.

(1) Jute completely delignified by treatment with sodium chlorite develops a yellowish colour on exposure to light and air or on heating for a few hours in the dark and this occurs to approximately the same extent whether or not the fibre has previously been extracted with alcohol-benzene in a soxhlet. It may be concluded that the fats, waxes, etc., removable by alcohol-benzene are not responsible to a very important extent for the after-yellowing. Moreover, since it has been shown by Chatterjee and Sarkar[6] that removal of lignin is complete by treatment with sodium chlorite under the conditions employed, the yellowing, observed on storage in diffused daylight for a few months or on heating to 105° C. for a few hours, is not due to presence of lignin itself. Of course, in jute bleached by treatments that leave part of the lignin in the fibre, the lignin may contribute to the yellowing that is observed. The most obvious possibilities that remain are that the yellowing is due to (*a*) small quantities of lignin decomposition products, (*b*) hemicelluloses or degraded hemicelluloses and (*c*) degraded cellulose, for

example, oxycellulose, and experiments have been made in an attempt to narrow down this field.

(2) In order to remove lignin decomposition products that may remain in small amounts after treatment with sodium chlorite, the delignified jute was extracted at room temperature with dilute solutions of (*a*) sodium bisulphite, (*b*) sodium sulphite, (*c*) sodium thiosulphate, (*d*) sodium bicarbonate, (*e*) ferrous ammonium sulphate, (*f*) caustic soda, (*g*) calcium hydroxide. The fibre still showed considerable yellowing in all cases when heated to 105° C. for three days, but it was less than in samples that had not received the subsequent treatment, particularly in the treatments with caustic soda and calcium hydroxide. Extraction of the delignified fibre with alcohol, acetone, chloroform or benzene did not prevent after-yellowing. We have not yet attempted to ascertain to what extent the treatments with sodium sulphite, etc., actually remove lignin decomposition products that might be present or to determine to what extent there was a simultaneous removal of hemicelluloses, degraded hemicellulose, or degraded cellulose but it is likely that sodium sulphite, for example, is effective in removing lignin decomposition products and the fact that considerable yellowing still occurred points to the conclusion that hemicelluloses, of which at least 20 per cent. occur in the raw fibre, play an important part in the yellowing. Delignification by means of sodium chlorite under the conditions employed leaves the hemicelluloses practically intact.[6] It is known, too, that jute partially bleached by the use of mild alkaline treatments in conjunction with hypochlorite treatments is subject to considerable after-yellowing. In such treatments it is clear from the loss in weight (say 8 to 15 per cent.) that much of the hemicelluloses remain. Sodium chlorite is known to be mild in its action on cellulose and an important contribution to the yellowing by oxycellulose produced during delignification is unlikely. Further evidence of the part played by hemicelluloses in the yellowing is given by the following observations.

(3) Cellulose prepared from jute by Cross and Bevan's method is entirely free from lignin but retains some of the hemicelluloses.[8] It shows some yellowing on prolonged storage in diffused light, though much less than the holocellulose obtained by the chlorite treatment of defatted jute. This is regarded as partly due to the presence of oxycellulose and partly to the presence of residual hemicelluloses, though the importance of each is not easy to assess.

(4) As shown by Chatterjee and Sarkar (*loc. cit.*) partial removal of hemicelluloses by treatment with dilute (half per cent.) caustic soda at about 31° C., prior to delignification with sodium chlorite, materially diminishes the tendency to yellowing on heating at 105° C. The effects of other preliminary alkaline treatments were also examined and it was found that the more severe the treatment, the less is the tendency towards after-yellowing in the delignified fibre. It appears, therefore, that the lower hemicelluloses—those removable by the milder alkaline treatments—play an important part in the yellowing. Cross and Bevan's cellulose and Norman and Jenkins's cellulose have lost the lower hemicelluloses and show a small tendency to yellowing, comparable with that shown by the sodium chlorite cellulose that has received a mild preliminary alkaline treatment.

(5) Cellulose prepared by treatment with moist chlorine dioxide becomes yellow very quickly on storage or on heating; the yellowing is much more rapid than with chlorite cellulose. This is attributed to the combined effect of the practically complete retention of hemicelluloses and of the degradation of both cellulose and hemicelluloses, the latter condition being indicated by the high copper number (Chatterjee and Sarkar, *loc. cit.*)

(6) Jute extracted with alcohol-benzene and then delignified with sodium chlorite did not become yellow even in fifteen months when stored immersed in alcohol, in a large boiling-tube, in diffuse day-light. This is presumably due to the virtual exclusion of oxygen from the holocellulose, the alcohol being preferentially oxidised by any oxygen that passes into it. Both reducing and acidic products were detected in the alcohol. A sample of delignified jute stored under benzene is being kept under observation, but it is too early to report results.

(7) By treatment with dilute alkali at room temperature the dull yellow colour of delignified jute, developed during storage, can be removed almost completely. It is yet to be seen whether the treated samples again turn yellow during storage, though, as stated in Section (2) above, an improvement has already been found after treatment with dilute caustic soda.

Conclusion: The foregoing observations are consistent with the view that the hemicelluloses of the jute fibre, which form at least 20 per cent. of its bone dry weight and are retained in delignification by means of sodium chlorite, are largely responsible for yellowing during storage. They may suffer some degradation during the chlorite treatment and further degradation in storage by light and oxygen would explain the results observed. Yellowing of the hemicelluloses, or degraded hemicelluloses is not, of course, regarded as the sole cause of yellowing of bleached jute. If, in addition to hemicelluloses, the bleached fibre contains residual lignin, or lignin degradation products or a considerable proportion of degraded cellulose (*e.g.*, oxycellulose) yellowing may be expected, and other non-cellulosic impurities may play a part. The practical bearings of the matter lie in the fact that if, as it appears, hemicelluloses play a major role in yellowing, it becomes very important to study the possibilities of removing hemicelluloses, or that portion of them which is mainly responsible for the yellowing, without unduly detracting from the strength of the fibre, particularly its wet strength. It is known that even mild alkaline treatments, before or after treatment with chlorite or hypochlorites, may very considerably reduce the wet strength: the problem is, therefore, a difficult one. Lignin cannot in practice be removed without some oxidative treatment (as with hypochlorites, chlorites, peroxides, permanganates) and such treatments cannot be given without producing some oxycellulose. Treatments to remove oxycellulose

and to remove hemicelluloses must include alkaline treatments, with the danger of removing the intercellular cement, at least in part. A compromise seems indicated—the use of the mildest oxidative and alkaline treatments that will give a worth-while result; pure cellulose will not be obtained and some after-yellowing must be faced. The problem is to find the conditions that give the best compromise. The alternative is to scour thoroughly and chemick mildly obtaining practically pure and very slightly degraded cellulose but very poor yarn or fabric strength; then we may attempt to introduce an artificial resin to replace the natural cement lost in bleaching.

Whether it may be possible to put some substance on the bleached fibre which, like alcohol, will be preferentially oxidised and so prevent yellowing for a considerable period remains to be seen. There are many difficulties; the substance would, in the case of goods that are exposed to the weather, have to be insoluble in water and in the case of goods that are to be laundered, it would have to be fast to washing. Laundering presents its own problems; we may produce a bleached jute material that retains fairly good wet-strength but experience shows that in repeated launderings there is a progressive loss in strength, no doubt due to the progressive removal of the inter-cellular cement. This has caused difficulties with tropical suitings made from a cotton warp and a partly bleached jute weft.

1. Kuchinka, *Melliand Textilber.*, 1939, **20**, 643, 706, 759, 804. 2. B. P., 561, 834 of the Mathieson Alkali Works, New York. 3. Ridge and Little, *J. Text. Inst.*, 1944, **35**, 134. 4. Giertz, *Svensk Papperstidn.*, 1945, **48**, 317. 5. Elgin, *U.S. Patent*, **1945**, **2**, 372, 561, Princeton. 6. Chatterjee and Sarkar, *Proc. Nat. Inst. Sci.*, 1946, **12**, 23.

FOREIGN CO-OPERATION IN THE DEVELOPMENT OF INDIAN INDUSTRIES

IN the course of his Presidential Opening Remarks at the Third Quarterly Meeting of the Central Committee of the All-India Manufacturers' Organization, held on December 22, 1946, Sir M. Visvesvaraya revealed that there had been offers of co-operation for starting new industries or companies in India. Some foreign business firms were ready, on reasonable terms, to work out new schemes, tender technical advice and arrange to procure and supply the machinery needed. Some of those firms were prepared to find capital if reliable groups of industrialists in this country felt the need.

During their discussions with the associations and business men, consulting engineering firms and others, he said that they took care to tell them again and again that promoters of new industries here were not likely to accept technical advice, machinery or even share capital for industries in India unless the control of every such concern was in Indian hands. He felt that this condition could be assumed and suggested that if the Government had no particular objection, groups of industrialists or business men, eager to establish new heavy industries in any part of the country, might be encouraged to begin collecting preliminaries and making preparations with a view to starting construction at the earliest favourable opportunity.

He had often thought that the importance of industries was not correctly understood by the people of India. In no country were industries promoted unless political power was behind it. In the absence of any sound industrial policy or drive on the part of the Government, the business public had been suspicious and slow in investing in industries. As has often been said, a balanced development of both Agriculture and Industries was essential for increasing the earning power and standard of living of our people. As far as possible all ordinary wants in the shape of consumer goods should be met by local production. Success in modern warfare was preponderatingly dependent on armament machinery, which was a product of highly developed skill, particularly in the manufacture of engineering industries. Industrial progress was vitally connected with the defences of a country.

Concluding his address, Sir M. Visvesvaraya declared that "now even more than formerly, in this closer-knitting of the world, the men with knowledge and skill will have the upper hand everywhere and the ignorant and the unskilled will be relegated to a subordinate place under some one or other strong power.

"In our country, peoples' thoughts and practices are still guided to some extent by religion and tradition. Tradition is often a wrong guide in the face of modern discoveries. Americans have been almost always against it and they take every opportunity to carry out reforms and developments. Hence they have become the most prosperous and powerful nation in the post-war world.

"If we educate our 340 million population, now illiterate, and teach them modern business habits and practices, the country will acquire enormous power for increasing production and good living.

"People in India should be economically united as are people in the United States of America, Canada and the United Kingdom. The nation-building activities I have referred to cannot be delayed without great loss. Unity among the population is required for its economic safety even more than the political. Economic unity cannot be delayed without further impoverishment of the population and curtailment of their subsistence needs. The chief elements of progress are unity of purpose between the Government and the people, team spirit in industry, co-operation between all classes of population in business and social life, and a strong resolve to work more and work better on the part of every individual citizen and his family. If the Government and the people become united in policy and action in this way rapid progress will be speedily achieved and the country will be bringing into existence a new national life."

SEASONAL RELATION BETWEEN NORTH AMERICA, SOUTHERN MONSOON AND WINTER RAIN IN NORTH-WEST INDIA

BY S. L. MALURKAR

(Poona 5)

THE south-west monsoon is dependent on the incursion of equatorial maritime air (Em) from the south. A series of low pressure area or 'pulses' moving westwards just south of the equator cross into the northern hemisphere and give rise to Em there.[1] These low pressure areas or 'pulses' could be traced to the high pressure area over South America[2] in southern winter. Climatic charts show that the winds in S.E. Pacific Ocean west of North Chile and of Peru are steady and moderate to strong during that period. If the northern or north-western portions of the high pressure area about this region are considered, the resulting wind stream would be easterly.

During the pre- and post-monsoon months in India, the northward passage of the 'pulses' is necessary for the formation and maintenance of tropical cyclonic storms or depressions.[3]

In southern summer, fresh 'pulses' from the north cross over to the southern hemisphere to form and maintain tropical cyclonic storms and depressions and help to intensify the seasonal low pressure area there. These 'pulses' can also be traced to the east of the place where they crossed over into the South Indian Ocean along the corridor of low pressure just north of the equator and south of the winter Asiatic high. The climatic charts show that the winds in the north tropical region of East Pacific (west of California and Mexico) are steady and moderate to strong due to the high pressure area over the United States of America and North Mexico in the northern winter. The arguments of advection of air from this region to the South Indian Ocean would be similar to that used for the Indian Monsoon and the time lag of 30 to 45 days would be equally applicable.[4] The 'pulse' that enters the South Indian Ocean would be one of the secondaries of the low pressure area originating from the southern or south-western portions of the North American high. The main factor that controls the monsoon in the South Indian Ocean with a positive relation should be the pressure of the south or south-western portions of the North American high a month or a month and a half before the epoch considered. The regions that can be expected to modify the passage of the 'pulse', once it has left North America, are :

(*a*) The low pressure area over the North Pacific Ocean should not be too marked or extend to too southerly latitudes.

(*b*) The winter high pressure area over Asia should not extend too far south in the pacific as then the 'pulse' would move into the S. Pacific.

(*c*) The seasonal high pressure area over the S. Pacific should be well developed and this prevents a premature crossing of the 'pulse' into the S. Pacific.

(*d*) The seasonal high pressure area over the western regions of Asia should be well developed to allow the 'pulse' to cross into the S. Indian Ocean.

(*e*) The seasonal low pressure area in the S. Indian Ocean must be normal in position and intensity.

(*f*) The general circulation (also wind speed) north of the equator must be adequate.

The time lag between these factors and the epoch of the southern monsoon decreases successively so that the time between the crossing of the equator by the 'pulse' and strengthening of the monsoon low in the south may be about three to four days.

The southern monsoon low pressure stretches over the South Indian Ocean and a foreshadowing of the seasonal weather there has not a great practical value and would not be quite exciting as in the case of the Indian monsoon which affects a considerable portion of the world population.

An indirect effect of the southern monsoon over N.W. India is important from the point of view of wheat crop there. The winter rain over N.W. India is due to 'western disturbances' which are often diffuse secondaries of extra-tropical depressions moving from west to east. The rainfall and movement of these diffuse and complex low pressure areas become clear if they are separated out into successive secondaries all of which move (with varying speeds) in an east-north-easterly direction.[5] In the absence of tropical cyclonic storms or depressions south of the equator, the western disturbances give a good distribution of rain in N.W. India, occasionally reminding one of a 'monsoon day'. If there be a tropical cyclonic storm or a depression south of the equator (but not too far south) in the Indian Ocean, the lower secondaries of the western disturbances are either not formed or at best ill-defined over N.W. India and produce scanty rain.[6] The winter rain in N.W. India should be negatively indicated with the monsoon in S. Indian Ocean and hence negatively correlated with the North American pressure with the necessary time lag. This was an important point that could be checked.

To get as representative a value of the pressure as possible over the high pressure area of the south and west high of the U.S.A., the mean pressure of four stations was taken: Portland (Oregon), St. Louis (Mis.), Galveston (Texas) and San Diego (Cal..). for the period 1876-1930. The pressure for October and November was correlated with rain over N.W. in the succeeding January to March period (the rain in December is small). The value of

C.C. of North America South and Western portions (Oct.+Nov.) Pressure to N.W. India rain in succeeding Jan. to March was —0.38, the Probable error being 0·09.

The other important question that arises is the relation between the north-east portion and the winter high over America and the Indian weather. This portion would give rise to westerly winds. It is well known that this region is the starting point of the Atlantic depressions that affect the temperate latitudes, or the extra-tropical depressions one of whose successive secondaries affect India in the winter. A high pressure area over the north-east portion of the high over N. America in winter should help in the formation of extra-tropical depressions and hence in the formation of secondaries that affect India. Other things being equal more secondaries would mean more rain in N.W. India. Hence the rain in N.W. India should be positively correlated with the pressure in the north-east portion of the winter high over N. America. As the speed of the westerlies in temperate latitudes is much greater than the easterlies in the equatorial latitudes, the time lag between N. America and N.W. India would be about 15-20 days only. Hence the contemporary correlation coefficient would have to be tried if a period of about three months is taken for rain. The stations that were chosen to represent pressure were Chicago, Albany (N.Y.) and Washington.

C.C. of North America (N.E. Portion) Jan. to March pressure to contemporary rain in N.W. India was 0.194 for the same number of years (1876-1930). This is significant to 80% level.

(The correlation coefficients were calculated by Mr. K. S. Ramamurthy for me.)

It is interesting to notice the behaviour of different portions of the North American winter high towards rain in N.W. India. If the North American high pressure area remained abnormally high throughout the southern winter, it follows that due to the southern and western portions of it, the winter rain in N.W. India should be defective and due to the influence of the north-east portion of the high pressure the rain in N.W. India should be abundant. Different portions of the same high pressure area exercise opposing influences. In other words, the high pressure area acts as a sort of balancing factor to N.W. India rain. The passage of western disturbances from west to east would pull the 'pulses' or low pressure areas travelling in lower latitudes and may occasionally prevent their crossing of the equator and may create a "break," in the monsoon in the southern hemisphere. Or the high pressure area may also act to a certain extent as a balancing factor for the southern monsoon also.

It appears probable that even for the Indian monsoon, one portion of the southern high near S. America may give rise to 'pulses' moving westwards and ultimately producing the S.W. monsoon in India. A more southerly portion of the high may give rise to extra tropical depressions, which travel in the southern hemisphere from west to east, may pull down the monsoon pulses and create a "break" in the Indian monsoon.

The high pressure belts away from the equator on either side of it seem to act as stabilising factors on the weather on the two sides of the equator, one being more prominent in northern summer and the other in southern summer.

1. *Forecasting Weather in and Near India*, S. L. Malurkar. Printed limited number in May 1944, p. 34. 2. *Ibid.*, 119. 3 *Ibid.*, p 87 4. *Ibid.*, p 120, ... 5. *Ibid*, p. 101. 6. *Ibid.*, p. 105.

RAINIEST SPOT IN THE WORLD

By H. L. CHHIBBER

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It was surprising to observe that even the standard books on climatology gave varying data about the rainiest place in the world. H. F. Blanford in his book on *The Climates and Weather of India, Ceylon and Burma*[1] (p. 73), has given the average monthly and total annual rainfall of Cherrapunji as follows:—

W. G. Kendrew in his book on *The Climate of the Continents*[2] (p. 351), has stated that "the west side of Kamerun Peak has 412 inches *per annum* near sea level, the second highest record in the world, surpassed only at Cherrapunji (India) which has 458 inches", while on p. 131 of the same book 428 inches is given as the annual mean rainfall for Cherrapunji

Elevation in feet	Jan.	Feb.	March	April	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
4,455	0·6	2·6	9·0	29·6	50·0	110·0	120·5	78·9	57·1	13·6	1·8	0·3	474·0

The monthly average of rainy days on p. 74 is given below:

Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.	Total
2	4	10	20	25	26	29	28	24	12	3	1	184

Referring to p. 222 of the same treatise the following figures are given for the mean rainfall of Cherrapunji.

Cherrapunji	Altitude in feet	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
	4.309	0·7	2·1	11·7	30·8	46·2	96·8	98·2	76·5	46·1	16·7	1·9	0·2	427·9

The same author in his book on *Climate*[3] (p. 141), has stated: "The very high mean of 412 inches is recorded near sea-level on the south-west side of Kamerun Peak, where a south-west wind blows on-shore for the greater part of the year, and there is certainly much more on the higher slopes; the heaviest rains are from June to October, the months when the monsoonal indraft is strongest. Kamerun is situated about 5° N. lat. and this too tends to give it its wettest season in the northern summer. There are stations outside the equatorial belt which have a large rainfall." On pp. 39-40 of *Climatology*,[4] by Austen Miller, it is recorded: "the heaviest rainfalls in the world are recorded under such conditions, Kauai[1] in the Hawaiian Island, has an average rainfall of 476 inches and *Cherrapunji, in Assam, has* 450 *inches.*

In the same connection, W. G. Kendrew in his book on *Climate*, has recorded on p. 145[2]: "the north-east trades of the Pacific Ocean meet such a barrier in the Sandwich Islands, while the volcanic mountains rise steeply from the Ocean to 13,000 feet; on Mount Waialeale (5,080 feet) in the Island of Kauai a high cliff facing north-east forces the Trade winds to rise almost vertically, and the rainfall is both heavy and continuous. The records are *slightly uncertain* owing to the difficulties involved in reaching this remote and elevated spot in order to reach the rain-gauges, but it seems that the mean daily rainfall is over 1 inch and the annual mean over 400 inches. This is among the highest figures recorded on the earth."

Finding such great discrepancies in standard works on climatology, it was deemed advisable to refer the matter to the India Meteorological Department since relevant references were not available at Benares. The Dy. Director-General of Observatories, Poona, informed me that there are at present three rain-gauges at Cherrapunji with annual total rainfall as tabulated below:—

CHERRAPUNJI RAINFALL
(*Average Annual Total*)

I. *Provincial rain-gauge, located in the Police Station* (started in 1871):
   (1) From Blanford's. This average is based on data before 1899—474″.
   (2) From 'Rainfall of India', *Memoirs*, Vol. No. XIV. Average based on data from 1872 to 1900. (This publication appeared in 1902)—457″·8.
   (3) 1920 normal. Based on data upto 1920 (49 years)—427″·8.
   (4) 1940 normal (70 years)—425″·5.

II. *Rain-gauge at Cherrapunji Welsh Mission House* (opened in 1903):
   Average 1903-1920 (18 years)—441″·7.
   1940 normal (38 years)—459″·6.

III. *Rain-gauge at Cherrapunji Observatory* (opened in 1906):
   1940 normal (35 years)—425″·2.

Monthly and Annual Rainfall (in Inches)

Station	Lat °N	Long.	Height	Length of record yrs.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
1. Cherrapunji (Police Station) Provincial rain-gauge	25°16′	91°44′E	4,309	70	0·73	1·91	9·92	28·80	49·82	100·35	95·85	73·11	45·95	16·74	2·06	0·22	425·46
2. Cherrapunji (Welsh Mission House)	25°16′	91°44′E	4,309 Approx	38	0·86	2·28	7·58	28·61	52·67	114·71	106·04	76·61	44·39	21·66	3·59	0·59	459·59
3. Cherrapunji (Observatory)	25°16′	91°44′E	4,309	35	0·75	2·11	7·27	26·23	50·44	106·05	96·34	70·08	43·35	19·42	2·70	0·49	425·23
4. Waialeale (Kauai Is.)	22°4′	159°30′ W	5,075	20	*	*	*	*	*	*	*	*	*	*	*	*	460 20
5. Debundja (Nigeria)	4°5′	8°59′E	16	14	7·91	11·26	16·06	18·11	25·43	58·35	63 03	54·21	61·42	46·34	24·06	13·39	399·57

Note.—Not available. Data of 4 and 5 taken from *Climate and Mean*, published by the United States Department of Agriculture.

In the above table are given the monthly and annual rainfall figures for the three rain-guages in Cherrapunji along with its co-ordinates, height above sea-level and the length of record. The same figures for Waialeale in Kauai Island (as far as available) and Debundja in Nigeria are also tabulated.

Waialeale, Kauai Island, Hawaii territory, according to data in *Climate and Man*, a publication of the United States Department of Agriculture, has an average annual total rainfall of 460 inches. No monthly figures are available and the average is based on data of 20 years only. This average, however, is not supported by the data of annual rainfall for the years 1912 to 1930, given in *Hawaii, Rainfall Records*, by Jhon R. Thomas. The figures for Waialeale are reproduced in the table in the previous column.

MT. WAIALEALE (Hawaii Territory)

Year		Rainfall in inches
1912	..	414·00
1913	..	451·00
1914	..	—
1915	..	—
1916	..	521·00
1917	..	—
1918	..	—
1919	..	204·00
1920	..	549·00
1921	..	367·00
1922	..	452·00
1923	..	360·00
1924†	..	228·00
1924–25*	..	362·40
1925–26*	..	219·60
1926–27*	..	408·24
1927–28*	..	—
1928–29*	..	354·22
1929–30*	..	301·95

* From July 1 to July 1.
† Records of six months.

In view of the foregoing and also the much longer period of 38 years on which the average of the rainfall at the Welsh Mission House, Cherrapunji, is based, it may be taken that the rainfall of Cherrapunji is higher than that of Waialeale.

With regard to other places having high rainfall it may be noted that Mawsynram a station near Cherrapunji, has records of a few years which show that it has a rainfall of well over 400 inches. No average is given as the period of data is short.

The only other station known, which has an annual rainfall of 400 inches or over is Debundja in Nigeria. Its average annual rainfall based on data of fourteen years only is 400 inches.

From the above it appears that Cherrapunji receives the heaviest rainfall in the world. Next to Cherrapunji and Mawsynram, the places of heaviest rainfall seem to be Waialeale and Debundja.

I wish to express my great indebtedness to the Deputy Director General of Observatories, India Meteorological Department, for kindly helping in elucidating this important matter.

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NEW METHODS OF PRODUCING HIGH ENERGY PARTICLES

By G. SURYAN and C. K. SUNDARACHAR
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THE extension of our knowledge in respect of the meson and the short-range forces inside the atomic nucleus awaits the development of laboratory techniques accelerating charged particles to cosmic-ray energies. The relativistic increase in mass leading to a change in frequency sets an upper limit to the energy of a well-defined beam of ions in the cyclotron. Devices which give promise of attaining energies in excess of 200 Mev. are the (1) betatron, (2) synchrotron, (3) relativistic cyclotron, (4) microtron, (5) linear resonance accelerator and (6) linear wave guide accelerator. The first four bring about resonance acceleration in a steady or varying magnetic field and the last two make use of micro-waves.

The induction electron accelerator called the *betatron* was perfected by Kerst.[1] A stream of electrons shot tangentially into a toroidal vacuum chamber placed between the pole-pieces of an A.C.-fed electromagnet gets accelerated in the electric field induced by the changing magnetic field. Decrease of the field with the radius gives rise to magnetic focussing, resulting in a fine output beam. The magnet of the 100 Mev. betatron built by the G.E. Co. at Schenectady weighs 130 tons, has a pole-face of 16 inch diam., and is fed by a 60 cycle A.C. at a full load of 200 KW. Although it may be possible to raise the energy to 500 Mev. by proper adjustment of the time dependance of the field, the loss of energy by radiation will be considerable at the higher energies.

The *synchrotron* due to Veksler[2] and McMillan[3] uses a time-varying magnetic field as in the betatron and a split thin-walled dee system connected to a high voltage generator as in the cyclotron. The inherent phase stability of the orbits brings about automatic synchronisation and makes up for moderate energy losses. When accelerating heavy particles, the damping of the phase oscillation set up by the radial displacement of the orbit may be compensated by motor-driven tuning devices. If the radiation loss per turn can be reduced in respect of the amplitude of the dee voltage,

1000 Mev. energies may possibly be reached. The Metropolitan-Vickers have under construction a 300 Mev. electron synchrotron and the Birmingham University a proton synchrotron.

Relativistic cyclotrons producing ions of energy more than 200 Mev. can be constructed if the problem of space and time variation of the magnetic field are solved satisfactorily. Arrangements are in progress to convert the 184-inch Berkeley cyclotron into a frequency modulated instrument (synchrotron cyclotron). It is expected that a dee voltage of only 50 kV. will be able to generate one micro-ampere of 200 Mev. deuterons.[1]

The *microtron* is an electron cyclotron where the particles are made to slip one cycle of phase in each circuit. A micro-wave resonator located near the edge of a uniform magnetic field gives rise to the necessary electric field. The use of a split magnet and several resonant cavities in series worked by a single power source is suggestd by Schwinger to compensate for the drift in the orbits. The short acceleration time of the electrons makes the radiation loss negligible and the large separation of the orbits facilitates the easy removal of the output beam. Electrons of 1000 Mev. energy can be produced if defocussing can be counteracted by proper shaping of the magnetic field or by the insertion of a loosely coupled parallel series of resonators.

The *linear resonance accelerator* uses an array of high Q resonators operated at a metre wave-length and pulsed simultaneously. When used for accelerating ions, a loosely coupled co-axial line, driven by a master oscillator and loaded suitably, may be employed to phase the system. Radiation losses are at a minimum and the equipment is inexpensive compared to the magnetic devices. A 450-metre long system may be needed to generate 300 Mev. electrons. The *linear wave guide accelerator* developed in the M.I.T. Radiation Laboratory consists of an array of tightly coupled resonators operated from a single oscillator. If difficulties connected with the accurate construction of wave guide sections to avoid the propagation of unwanted modes and the provision of an automatic tuning to overcome temperature and other variations are successfully tackled, it may be possible to speed up electrons to 1000 Mev. energy. A detailed discussion of the working and possibilities of the new devices is given by Schiff.[5]

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WHAT IS MASS?

BY D. FERROLI, S.J., D.SC.

1. *Tentative Definition.*

IN text-books which are very widely used, we find the mass of a body defined as "the quantity of matter it contains".

Matter is tentatively defined as "that which can be perceived by the senses" (*confr.* Loney, *Dynamics of a Particle*, pp. 4-5).

Hence, colour, sound, electricity, magnetism would presumably come under the *genus* "Matter". I wonder whether many would agree to this. Another definition is: "Matter is that which can be acted upon by, or exert force".

So matter would be both active and passive, under different circumstances. Could perhaps, matter, under its active aspect ("that which can exert force") be identified with energy?

The author in question is aware of the imperfection of his definition, for he adds: "Matter, like time and space, is a primary conception, and hence it is practically impossible to give it a precise definition".

2. *Mass under a triple aspect.*

As the student advances, he meets the concept of mass under three aspects:

(*a*) From the first fundamental equation of Dynamics: Force = Mass × Acceleration, one would deduce that mass is a *coefficient of inertia*, it is something passive, something which, in a way, tends to resist acceleration.

(*b*) In the second fundamental equation of Dynamics: Mass × Velocity = Acceleration × Time, the mass assumes a slightly different connotation; it is a *capacity of impulse*, it is something which contributes to the momentum of a body. The contribution, however, does not seem merely passive, but active, as a man who tries to stop a roller or a cricket ball, would experience.

(*c*) Finally in the equation of energy E = Half the mass by the square of velocity, the mass is a capacity of *kinetic energy*—not energy really, but something that can be energised, invested, so to say, with energy. The passive aspect of mass is again prominent.

3. *Mass in Relativistic Mechanics.*

In Relativistic Mechanics the above three definitions of mass do not give the same values. In fact, even before Einstein, one met in Higher Mechanics the Maupertuisian Mass, the Hamiltonian Mass and the Leibnitzian Mass.*

The present writer has dealt at length with their conceptual significance in his *Madras University Lectures* (March 1927), which were published by the University in 1929. Here it may be sufficient to point out that:

(*a*) If mass is a *coefficient of inertia* then it is necessary to consider two masses: *the longitudinal* mass, when the force is parallel to the velocity; and the *transversal mass*, when the force is

* Of which the Maupertuisian mass is the mean of the Hamiltonian and the Leibnitzian masses.

perpendicular to the direction of the velocity.

Both vary with the velocity, but according to different laws. They are equal when the velocity is zero.

(*b*) If mass is considered as *a coefficient of impulse*, then there is only the transversal mass, which is independent of the direction of the force.

4. *A Query.*

Now it may be asked: If a different direction of force leads to a different conception of mass, are the respective formulæ merely a result of different definitions of time and space, or do they point to a different and real configuration of the particles constituting the mass in question? For it is conceivable that a different configuration may afford a different reaction, according as the force is parallel, or perpendicular to the velocity. Now is the different configuration produced gradually or instantaneously? And if gradually, what would be the mass when the force is in a direction which is neither along, nor perpendicular to the direction of motion? A solution which is based on the parallelogram law seems unsuitable, for in Relativistic Mechanics, velocities are not compounded according to the parallelogram law.

5. *Classical Definition of Mass is discarded.*

It is clear, however, that the classical conception of mass, as a definite quantity of matter in a body, is thrown overboard. Similarly the idea is abandoned that mass is something which remains constant throughout all the transformations of matter; on the contrary, mass varies with the velocity of matter.

But one may reasonably ask the meaning of these words "mass varies with the velocity of matter", when matter has been emptied of what seemed to be its most fundamental attribute—that of mass and inertia. In fact, if mass varies, can we say that matter changes at all? Or, if it changes, what is it that remains constant throughout the change? For a change which is all change, without anything that really changes is difficult to conceive. Or have we, perhaps, to go back to Aristotle's *"prote ule"* which is the same throughout all changes, not being liable to "corruption and generation"?

6. *Is Matter also to go overboard?*

H. Poincare begins his most suggestive chapter on *"La fin de la matiere"* with the words: "L'une des découvertes les plus étonnantes que les physiciens aient annoncées, c' est que *la matiére n' existe pas*". And yet is there not a way of saving the existence of matter?

In the theory of the cathode corpuscles, unchanging mass still leaves its traces quite discernible, though it is almost nil in comparison with the electro-magnetic mass which is revealed by the phenomenon of *self-induction*. But in Einstein's conception an unchanging mass finds no place whatever. Again, the negative corpuscles, though apparently endowed with inertia, borrow it entirely from the æther, whilst, according to Einstein, the inertia of a moving body is inherent in the body, though it changes with the directed velocity of the body itself, and has nothing to do with the æther, for the æther, itself is done away with. According to Lorentz, matter has no existence, and what we call matter is but a hole in the æther. For M. Langévin, matter is only liquid æther, which has lost its properties. Matter in motion is not liquid æther moving through ordinary æther, but it is merely an extension or propagation of liquefaction, the æther gradually melting in one direction and solidifying in the direction opposite to the direction of motion. Hence moving matter would constantly lose its identity.

Einstein does away with these interesting suggestions; for him matter is but a mathematical function with the power of reaction on a fourfold geometrical variety, which may be called the *time-space* or the *chronotope*.

7. *The Kingdom of Nominalism.*

But is this modern tendency to change everything into mathematical formulæ a healthy one? Mathematicians think they simplify things. Rather than simplifying them, they etherialize them into the purest gossamer. In the XVI century a reaction set in against the hair-splitting exaggerations of the later scholastics. It was a healthy reaction: the reaction of Induction against exaggerated Deduction, the reaction of observation against abstractions, the reaction of objective against subjective science. Now abstractions have come back—no less insidious, because dressed in a mathematical garb, Nominalism seems again to have taken its seat among scientists. It is true that mathematics deals with *symbols*, but its symbols must be capable of some interpretation. Now, what is the interpretation to be given to *mass*? and if *mass* cannot be interpreted apart from matter, what is the interpretation to be given to *matter*? .... One does not want to be flippant, but *Punch's* joke seems appropriate: "What is matter? Never mind". "What is mind? No matter".

Or perhaps Bertrand Russell's paradox: "Mathematics is the science in which we do not know what we are talking about, and do not care whether what we say about it is true."

Science seems to have turned full circle. Descartes was satisfied with the truth of a statement only if it could be given a mathematical expression. Aristotle maintains that *"In mathematicis non est bonum"*. No good in mathematics ..... or is it in the mathematicians? .....

THE CILIATE MACRONUCLEUS

BY B. R. SESHACHAR AND K. V. SRINATH

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IT is now fairly clear that so far as staining reactions are an indication, the ciliate macronucleus contains a large amount of desoxyribose nucleic acid.[1] This is a matter of major significance, for it has been known for a long time that no chromosomes are formed in it during division, which is of the amitotic type. The occurrence, therefore, of a large quantity of desoxyribose nucleic acid in a nucleus which admittedly does not form chromosomes deserves an explanation; for in other organisms, this has been seen to occur only in association with the chromosomes.

Chromosomes have, however, been reported to be formed in the macronucleus of *Tetrahymena geleii* by Painter[2] and earlier by Hegner and Holmes[3] in *Balantidium*. But these would appear to be exceptions; for normally the division of the ciliate macronucleus is by the direct amitotic type, without chromosome formation. In species of *Epistylis* with which the authors are particularly well acquainted, it is indisputably so.

The occurrence of desoxyribose nucleic acid in the ciliate macronucleus leads one to conclude that it exists there in a condition and relationship very different from those in which it is present in the metazoan nucleus. Recent work[4] on the behaviour of the nucleus in mitosis has shown that the polymerization of the nucleotides is dependent on the protein framework of the chromosome. In fact, the chromosome thread (protein) controls the polymerization of its thymonucleic acid charge, and if the chromosomes are not formed in the ciliate macronucleus, it is more than likely that the reason lies in the extent or nature of its protein content. This in turn is related with the reproduction of the thread, and so the division of the nucleus itself. It is clear, therefore, that the whole chain of events and reactions of mitosis hinge on this central fact of the protein content of the nucleus; and if, in spite of the presence of one of the essential constituents of the chromosome, *i.e.*, desoxyribose nucleic acid, the chromosomes are not formed by the macronucleus, it is clear that the other constituent, *i.e.*, protein, is in some way deficient. In fact, one is led to the possibility of visualising the ciliate macronucleus as a body which is either partially or completely lacking in protein, and that that is responsible for the non-formation of the chromosomes by it, and in turn, for its amitotic division.

If it is true that the desoxyribose nucleotides occur in the macronucleus in an unpolymerized condition and unrelated to protein, then this would offer the first instance, unique among animals, where desoxyribose nucleic acid exists outside of and dissociated from the chromosome thread. But it is also significant that almost alone among normal nuclei of animals, the macronucleus of the ciliate is the one that unquestionably divides by amitosis.

The growth and reproduction of the macronucleus offer other interesting points. Whatever the condition in *Tetrahymena*,[2] the macronucleus of most ciliates, and particularly of *Epistylis*, divides at every binary fission, by a simple process of constriction, and each daughter individual has a macronucleus much smaller than that of the parent. This means, a period of growth must follow binary fission during which the macronucleus must enlarge. Growth of the macronucleus must involve the addition of material to it, which we have seen, is largely desoxyribose nucleic acid. It can come from one of two sources. The existing nucleotides in the macronucleus of the daughter individual must reproduce; or new nucleotides, manufactured in the cytoplasm, must find their entry into the nucleus through the nuclear membrane. In the one case it would be a multiplication of desoxyribose nucleotides within the nuclear membrane; in the other, the ribose nucleotides, manufactured in the cytoplasm, must get converted into those of the desoxyribose type on their entry into the nucleus.

If the former possibility is admitted, it will provide the first instance of the multiplication of desoxyribose nucleotides outside the protein medium of the chromosome, where only they are known to do so. This, however, is not surprising, for nucleic acid has been shown[5] to possess the inherent property of self-multiplication.

The second possibility is full of interest. That cytoplasmic nucleotides occur in a variety of animal cells is now fairly well known. That they contribute to the nucleic acid content of the chromosome at mitosis is also clear, and evidences have been presented for a transference of cytoplasmic nucleotides into the nucleus at every mitotic cycle, through the nuclear membrane during early prophase, and more especially at pro-metaphase, when by the breaking down of the nuclear membrane, the cytoplasmic and nuclear materials are in confluence. So it is not surprising that ribose nucleotides pass after every binary fission into the macronucleus, become converted into those of the desoxyribose type and so augment the nucleic acid content of the macronucleus. But it is significant that a situation analogous to pro-metaphase occurs at no time in the history of the ciliate macronucleus, for never does it lose its nuclear membrane, nor does its material ever come in direct and open communication with the cytoplasm. Hence, if cytoplasmic nucleotides pass into the nucleus, they must do so through the nuclear membrane. Painter[2] has recently reported the presence of large quantities of ribose nucleotides in the cytoplasm of ciliates, and the formation of macronuclear buds and their disorganization in the cytoplasm[2,6] must release large quantities of nucleic acid there. These would find their way back, ultimately, into the nucleus at the time of its growth.

There is still a final point to which we would refer, *i.e.*, the origin of amitosis of the

macronucleus. It is to be assumed that in a normal nucleus capable of mitosis, a definite protein-nucleic acid ratio exists, and should be maintained. It is only on the basis of this assumption that the interaction between these two substances makes mitosis possible. Quantitative studies have shown that the chromosome which is more or less entirely a nucleoprotein, contains a 40 : 60 ratio of nucleic acid and protein.[7] Therefore it would seem necessary that a certain basic protein equipment would be required for the building of a chromosome. Any disturbance of this protein-nucleic acid ratio must have a deterrent effect on mitosis and must produce a condition when mitosis does not occur at all or is so disturbed that it degenerates into amitosis. On this view we may find an answer to the behaviour of the ciliate macronucleus. Of the two substances which alone are known to form the chromosomes, one of them, *i.e.*, desoxyribose nucleic acid, is present in it. And yet no chromosomes are formed. The reason probably is, as set out earlier, the protein-nucleic acid ratio has been upset, with the result that the chromosomes are not formed, and no mitosis occurs.

Why and how this ratio is upset may now be briefly examined. The behaviour of the conjugating ciliate immediately after syngamy appears to provide an answer. The synkaryon is capable of mitosis and divides a number of times. A distribution of the resulting nuclei among the daughter individuals takes place so that each comes to possess the normal nuclear equipment. Concomitant with this is the enlargement of some of the nuclei to become the macronuclei, while the others that do not enlarge, remain as the micronuclei. It is significant that the nuclei which do not enlarge retain the faculty for mitotic division, while those that do, lose it.

We would regard this enlargement as a process of acquisition of cytoplasmic nucleotides. On this basis, it is clear that against a known and fixed protein equipment of the original small nucleus, the addition of enormous quantities of nucleotides has so overloaded it with nucleic acid that the functional ratio between it and the protein has been upset, with the result that the macronucleus has been dispossessed of its vital attributes of chromosome formation and mitosis.

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VITAMIN A IN FISH LIVER OILS AND CAROTENE IN FOODSTUFFS

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THE vitamin A activity of some fish oils and foodstuffs has been reported previously from these Laboratories.[1-9] It was observed that the liver oils of some of the fishes that abound the waters along the coast of India are much richer in vitamin A than Norwegian cod liver oils. A number of fish oils has since been assayed for vitamin A and this paper embodies the results of such assays. The non-saponifiable fractions of the oils were used for the assays. The method adopted was either tintometric or spectrographic or both and was the same as described by Rajagopal.[7] The factor adopted for conversion of Carr-Price value of the oils into International Units of vitamin A per gramme was 53.

Some samples of foodstuffs and carotene concentrates were assayed for their carotene content by the tintometric method as described by Sekhon.[8]

RESULTS

TABLE I

Vitamin A content of shark liver oils estimated by the tintometric and spectrographic methods

Source (1)	C.P. values non-sap. (2)	Vitamin A I.U./g (by the spectrographic method) (3)	I.U. of vitamin A/g (Spectrograph method) / C.P. value on non sap. (4)
Calicut	1 003	46 550	46·4
do.	839	[illegible]6,510	43·6
do.	[illegible]51	28 490	51·7
do.	577	27 500	47·7
do.	382	20,640	54·2
do.	272	15,140	55·7
do	239	14,940	62·6
do.	298	14,910	50·1
do.	291	14 000	48·1
do.	107	6,860	64·2
do.	117	6,000	51·3
do.	56	2,780	49·8
do.	37	1,780	48·0
Ceylon	164	7,890	48·0
do.	69	3,870	56·2
Average	319	16 524	51·8

TABLE II. *Vitamin A content of shark liver oils estimated by the tintometric method*

Source	No. of Samples	Vitamin A in I.U. per g. Max.	Min.	Average
Alleppey ..	2	16,250	6,900	11,575
Baroda ..	1	4,000	4,000	4,000
Bombay ..	2	11,370	7,700	9,535
Calicut ..	4	12,780	6,250	8,428
Ceylon ..	7	7,400	1,189	2,736
Karachi ..	19	37,900	1,470	9,829
Trivandrum ..	17	18,500	1,090	8,533
Average ..	52	37,900	1,090	8,287

TABLE III. *Vitamin A content of blended fish liver oils appearing on the market as substitute for cod liver oil*

Source	No. of Samples	Vitamin A in I.U. per g. Max.	Min.	Average
Bombay ..	4	2,400	1,360	1,743
Calicut ..	7	1,600	700	1,251
Ceylon ..	2	1,680	1,000	1,340
Karachi ..	5	1,300	400	369
Kolhapur ..	1	1,140	1,140	1,140
Madras ..	13	1,200	76	396
Average ..	32	2,400	76	872

will be useful for infants and invalids who are unable to tolerate large doses of oil.

Table III indicates the desirability of having proper legislation to protect the interests of the consumer. Of the 32 samples assayed, only 15 were found to have a value of 1,000 or more I.U. of vitamin A per gramme. Hence it is essential that the law should insist that the vitamin A content of oils put on the market as substitutes for cod liver oil should have a minimum potency of 1,000 I.U. per gramme (B.P. standard).

It should be borne in mind that it is only the red carrot that is rich in carotene; the white and violet varieties are very poor in this constituent (Table IV).

SUMMARY

1. Sixty-seven samples of shark liver oils, obtained from various parts of India, were found to have an average vitamin A potency of 10,130 I.U. per gramme. It is concluded that a 'high potency' shark liver oil (10,000 I.U. per g.) can be placed on the market involving little effort.

2. Thirty-two samples of 'blended' fish liver oils had, on an average, 870 I.U. of vitamin A per g. The importance of enforcing standardization of vitamin A products by legislation is emphasized.

3. The carotene content of a few foodstuffs and concentrates is reported.

TABLE IV. *Carotene content of foodstuffs, red palm oils and concentrates*

	Botanical name	Source	Carotene content in μg. per g.
Carotene concentrate (3 samples) ..	—	Bombay	47,360
,, crystals (prepared from grass) ..	—	Calcutta	24,540
,, concentrate ..		Bombay	17,400
,, ,, (type 150°) (4 samples) ..	—	,,	12,600
Red palm oil (2 samples) ..	*Elaeis guineensis*	Manmad	600
,, (4 samples) ..	do.	Travancore	440
Amaranth, green ..	*Amaranthus gangeticus*	Coimbatore	120
do., red ..	do.	,,	105
do., spiny ..	*A. spinoses*	,,	101
do., Rangoon ..	*Amaranthus gangeticus*	,,	77
Carrot, red ..	*Daucus carota*	Ootacamund	105
do., violet ..	do.	,,	8·4
do., white ..	do.	,,	1·3
Palm fruit, juice ..	*Borassus flabellifer*	Cochin	33·8
Margarine (4 samples) ..	—	Bombay	9·3
Red gram, red ..	*Cajanus indicus*	Central Provinces	0·9
do., white ..	do.	,,	0·9
Spent yeast ..	—	Bihar	0·8
Cashew nut oil ..	*Anacardium occidentale*	Coimbatore	0·8
Soya bean milk ..	*Glycine hispida*	—	0·4
White ragi ..	*Eleusine coracana*	—	0·1
"Bel Vita" (a marmite substitute) ..	—	Bihar	Trace
Vanaspati (12 brands) ..	—	Sind	Nil

DISCUSSION

It will be seen from Tables I and II that most shark liver oils are very rich in vitamin A. Similar high values have been recorded for Indian fish liver oils by workers in other laboratories.[10-14] Column 4 of Table I indicates that the conversion factor 53, used for conversion of Carr-Price value into International Units per gramme, is justified. The average value for vitamin A assayed is of the order of 10,000 I.U. per gramme. Hence, merely by mixing of the oils, shark liver oil of this potency can be placed on the market which

1. De, N. K., *Ind. J. Med. Res.*, 1935 *a*, **22**, 509. 2. Idem., *Ibid.*, 1935 *b*, **23**, 505. 3. Idem., *Ibid.*, 1936, **23**, 937. 4. —, *Ibid.*, 1937, **24**, 737. 5. De N. K., Majumdar, B. N. and Sundararajan, A. R., *Ibid.*, 1938, **26**, 435. 6. Majumdar, B. N., *Ibid.*, 1941, **29**, 95. 7. Rajagopal. K., *Ibid.*, 1941, **29**, 575. 8. Sekhon, N.S., *Ibid.*, 1942, **30**, 529. 9. Idem., *Ibid.*, 1943, **31**, 141. 10. Datta. N. C., and Banerji, B. N. *Ibid.*, 1934, **21**, 535. 11. Ghosh, A R., and Guha, B. C., *Ibid.*, 1935 **22**, 521 12. Seshan. P. K., *Ibid.*, 1940, **27**, 711. 13. Niyogi, S. P., Patwardhan. V N., and Acharya, B. N., *Ibid*, 1943, **31**, 15. 14 Ahmad, B., Ram Chand and Mansoor-ul-Hassan, *Ibid.*, 1945, **33**, 215.

STATISTICAL METHODS IN PLANT AND ANIMAL BREEDING

A SYMPOSIUM on the application of Statistical methods to plant and animal breeding was held on the 26th and 27th December 1946, under the joint auspices of the Indian and National Academies of Sciences during their annual session at Allahabad.

Dr. Panse (Indore), who opened the discussion, dealt with the importance of plant breeding as a means of producing better crops without the need of any extra expenditure on the part of the cultivator. Considerable progress had been made in the past with this method of improvement and improved varieties of sugarcane, rice, wheat and cotton were already being grown on a fairly large acreage; but the plant breeder had still to cover a wide field, and in order that he should do his task efficiently, an increasing application of statistical methods to plant breeding was essential. Dr. Panse then considered the various problems that a plant breeder is confronted with in the initial choice of suitable material for selection, the process of selection in this material, and the maintenance of improved strains evolved as a result of selection. He pointed out that there were two criteria for the choice of material suitable for selection, namely, mean values and genetic variability. He illustrated with the help of data from a cotton-breeding experiment carried out at Indore, how these criteria could be measured and used. The superiority of the progeny-row technique on mass selection was in his view an essentially statistical argument. He then explained how statistical method could be profitably employed by the plant breeder at the different stages of his work thereby increasing his chances of success.

Dr. Sukhatme (Delhi) discussed the use of statistical methods in the field of animal breeding. He pointed out that animal breeding had lagged far behind plant breeding in the use of statistical methods, and illustrated, by means of data of an animal breeding project, how, owing to the lack of proper planning and statistical examination of the results obtained during the course of the project, it was discovered, after a period of ten years during which the scheme was in progress, that no real improvement was achieved. He explained how this conclusion was established clearly by a critical examination of the full results of the scheme with the help of statistical methods. While he felt that experimental techniques based on statistical principles had a more limited scope in animal breeding as compared to plant breeding, he emphasised the need for a careful examination of the progress of an animal breeding programme from the beginning by the use of appropriate statistical methods.

Dr. Ramdas (Poona) pointed out the meteorological aspect in plant breeding and explained how drought-resistance of crop varieties could be tested in glass houses under controlled humidity and temperature.

Mr. Koshal (Poona) discussed the statistical analysis of F_2 data for obtaining information of genetic interest with the illustration of fibre characters in three crosses between Cwn. 520, Bani and Malvi strains of cotton. He pointed out the need of randomised replicated trials right from the beginning of selection. Otherwise the breeder is often misled into selecting material on the basis of non-genetic variation and such selection proved futile when progenies are grown from the selected plants.

Mr. Kishen (Lucknow) explained the use of discriminant function for plant breeding. He also emphasised the need for randomised and replicated trials and suggested the use of modern incomplete block designs in plant breeding. He then considered the possibility of using similar designs in trials with animals.

Mr. Bokil (Indore) considered theoretically the relationship between hybrid vigour and F_2 and F_3 variances and gave their expected values for a variety of genetic hypotheses. Referring to Dr. Panse's suggestion that selection in F_1 is worth considering, he pointed out that the F_1 mean appeared a safe guide for selection generally on account of the fact that in none of the genetic cases he had considered, a larger variance in F_2 resulted from a lower F_1 mean.

Mr. Sahasrabuddhe (Indore) compared the efficiencies of various incomplete block designs against ordinary randomised blocks with special reference to cotton breeding with the help of data from a uniformity trial. He stated that his conclusion was that the simple randomized block layout was quite efficient for as many as 125 150 progeny plots of 5 to 10 feet long per block arranged compactly.

Mr. Thawani (Delhi) explained the principle of discriminant function and its use in plant selection. He referred to possible extensions of the simple linear functions that have been recommended.

Among other speakers that took part in the discussion, Dr. Chandrasekhar (Calcutta) stated that the statistical method was the only possible approach to the study of human genetics.

Mr. Ramiah (Cuttack), who summed up the discussion, agreed with the view that a close co-operation between the breeder and the statistician was necessary. The progress already made in this direction was, in his opinion, satisfactory, and he hoped with confidence that statistical methods will play an increasingly useful role in the work of crop and animal improvement in India.

NEW SCHEMES OF THE COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, INDIA

A sum of about Rs. 5·5 lakhs has been sanctioned for continuing the work of various research schemes in Universities and Research Institutions. Some of the new schemes that have been sanctioned are, development of high purity manganese, manufacture of Beryllium and its alloys, investigations on rare earth minerals, study of industrial wastes as supplemental sources of nitrogen and vitamins, investigations on micro-waves from extra-territorial sources and on Raman spectra of organic compounds.

LETTERS TO THE EDITOR

ELECTROLYTIC REACTIONS ON POROUS CARBON ANODES—PART I:
The Preparation of *P*-Benzoquinone by the Oxidation of Benzene

p-BENZOQUINONE is largely used in the dyestuff industry, in the preparation of hydroquinone, and in many processes of synthetic organic chemistry. It is mostly prepared by the oxidation of aniline by chromic acid. Its electrolytic preparation was attempted by Inoue and Shikata[1] who used lead peroxide as anode, and claimed a current efficiency of 81·5 per cent. Their results could not be confirmed by Seyewetz and Miodon[2] who obtained under identical conditions a current efficiency not exceeding 26 per cent. The latter workers obtained a current efficiency of 65 per cent., using lead peroxide as anode, and a bath containing 25 per cent. H_2SO_4, 33 per cent. CH_3COOH and 1·5 per cent. $PbSO_4$. The method, however, has not found any use in industry.

The advantages of using a thick-walled porous carbon tube closed at the bottom as anode are the following:—

(1) It is cheap and chemically inert under ordinary current densities.

(2) Catalytic materials which help anodic reactions can be easily deposited on the pores.

(3) It can function as a wick for the passage of benzene through the pores to the active surface of the anode and thus eliminate the need for vigorous stirring which is essential for high yields of *p*-benzoquinone according to Seyewetz, *et al.*

Thick-walled porous carbon tubes were soaked in solutions having different concentrations of potassium ferricyanide, taken out from the bath and the adhering solution wiped off. The tubes were then dried in an oven, and used as anodes. The electrolytic bath was composed of 2 per cent. sulphuric acid containing as catalyst, potassium ferricyanide of the same concentration as was used for impregnating the carbon anode.

Under certain conditions, a current efficiency of 51 per cent. in the electrolytic conversion of benzene to *p*-benzoquinone has been obtained.

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Dept. of Pure & Appd. Chemistry,
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Bangalore,
March 15, 1947.

1. Inoue and Shikata, *J. Chem. Ind. Japan*, 1921 **24**, 567. 2. Seyewetz and Miodon, *Bull. Soc. Chim.*, 1923, **33**, 449.

ELECTROLYTIC REACTIONS ON POROUS CARBON ANODES—PART II:
The Preparation of Chlorobenzene from Benzene

CHLOROBENZENE is now extensively used in industries for the manufacture of phenol, aniline, D.D.T., etc., and as a solvent. The well-known chemical method for the production of chlorobenzene is the chlorination of benzene in the liquid phase. The reaction is exothermal and needs careful control of temperature.

Researches on electrolytic chlorination of benzene have been fairly extensive. The latest is that of Croco and Lowy[1] who obtained with vigorous stirring (350 r.p.m.) a current efficiency of 75 per cent. using graphite anode. In our experiments stirring was eliminated, benzene was made to flow through the pores

of the anode by gravity and recycled through the anode for maximum advantage. The bath was composed of a solution of monochloracetic acid in concentrated hydrochloric acid and could be used continuously for a series of experiments.

Using iodine, ferric chloride, and cyanuric acid as catalysts respectively, current efficiencies of 33 per cent., 68 per cent. and 89 per cent. respectively were obtained at a current density of 0·026 amp. per square cm. at 38° C.

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March 15, 1947.

1. Croco and Lowy, *Trans. Electrochem. Soc.*, 1926, **50**, 315.

ELECTROLYTIC REACTIONS ON POROUS CARBON ANODES PART III: The Preparation of Ethylene Chlorhydrin and Ethylene Glycol from Ethylene

Ethylenechlorhydrin and ethyleneglycol are largely used as industrial solvents in the drug industry. The methods of preparation are based on the reaction between ethylene and hypochlorous acid formed by passing gaseous chlorine into water or by the action of boric acid on a hypochlorite solution. As regards their preparation by electrochemical methods, only three references could be traced.[1]

It has been found that ethylene on electrolytic oxidation on a porous carbon tube as anode in an electrolytic bath of sodium chloride, produces both chlorhydrin and glycol, the yield of each depending on experimental conditions. For example, working with a solution containing 10 per cent. sodium chloride at a flow rate of ethylene of 57 c.c. per hour per sq. cm. of anode surface, and a current density of 0·023 amp. per sq. cm., the current efficiency calculated on the basis of ethylenechlorhydrin has been found to be 91 per cent. at 1° C. and 1·1 per cent. at 91° C.; and calculated on the basis of glycol has been found under identical conditions to be 5·4 per cent. at 1° C. and 16·5 per cent. at 91° C. The reactions may be represented as follows:—

1. $CH_2 : CH_2 + OH^- + Cl^- = CH_2OH \cdot CH_2Cl + 2e$

2. $CH_2 : CH_2 + 2\,OH^- = CH_2OHCH_2OH + 2e.$

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March 15, 1947.

1. *B.P.*, 1916, **140**, 831; *U.S.P.*, 1918, **125**, 3615; *U.S.P.*, 1919, **1**, 308, 797.

ELECTROLYTIC REACTIONS ON POROUS CARBON ANODES. PART IV: Preparation of Chloral from Alcohol

Chloral is now an important intermediate in the manufacture of D.D.T. Chloral alcoholate obtained by the reaction of dry chlorine with dry alcohol is converted into chloral by sulphuric acid. Koidzumi[1] has done some work on the electrolytic preparation of chloral.

In our experiments the bath was composed of a concentrated solution of sodium chloride in a copper vessel which acted as a cathode. As the alcohol was gradually introduced into the anode compartment through the porous carbon anode it reacted according to the equation:—

$$CH_3CH_2OH + 8\,Cl = CCl_3CHO + 5\,HCl$$

The experiments were carried out at 100° C. so that the chloral formed distilled off immediately and was thereby removed from further anodic attack. It was found, that besides chloral and chloral alcoholate, other products like monochloracetic acid, ethyl acetate, monochloroacetaldehyde hydrates and alcoholate were obtained as by-products, the yields depending on experimental conditions.

Working with a saturated solution of sodium chloride maintained at a temperature of 100° C., at a current density of 0·04 amp./sq. cm. and using porous carbon impregnated with 6·5 per cent. by weight of cyanuric acid, the current efficiency calculated on the basis of chloral has been found to be 33·4 per cent.

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March 15, 1947.

1. Koidzumi, *Mem. Coll. Sci. Kyoto*, 1925, **8**, 155.

NOTE ON THE ESTIMATION OF CHROMIUM IN CHROMITE ORES

Chromium is generally estimated in chromite ores by fusing the chromite with sodium peroxide in a nickel or a porcelain crucible. Ordinarily a nickel crucible can stand 5-6 peroxide fusions while some of the porcelain crucibles could hardly stand two fusions. Added to this, the nickel peroxide formed during fusion requires long boiling before it is completely dissolved in sulphuric acid. The chief constituent that has to be analysed in the chromite ore is the chromium oxide (Cr_2O_3); sometimes iron oxide (Fe_2O_3) is also wanted. Silica is rarely required. In view of the scarcity and high cost of the nickel crucibles, the following simple method has been standardised employing a glass test tube for the peroxide fusion.

Sodium peroxide (1-2 g.) is introduced into a dry stout-walled test tube and finely divided

chromite ore (0·1-0·2 g.) is weighed in a narrow glass tube (4 mm. dia.) and introduced into the test tube taking care that the chromite does not stick to the sides of the test tube. A further quantity of sodium peroxide (1-2 g.) is added to the test tube, and the contents well mixed by gentle rotation of the test tube. After mixing, the contents are covered with a layer of sodium peroxide and gently heated over the flame to melt the peroxide. The peroxide is maintained in the molten condition for 15 minutes with occasional shaking and then the contents allowed to solidify. The hot test tube is introduced into a tall beaker containing a drop of water when the test tube develops cracks. After cooling, the mass is extracted with cold water, boiled to expel dissolved oxygen and acidified with sulphuric acid and the chromate estimated in the usual manner.

The following table gives the results of analysis by the two methods.

	Nickel Crucible Fusion	Test tube Fusion
Sample I	Cr_2O_3 — 44·50	44·54
	Fe_2O_3 — 40·29	40·18
Sample II	Cr_2O_3 — 47·75	47·62
Sample III	Cr_2O_3 — 47·[illegible]8	47·85

Iron is usually estimated by filtering the ferric hydroxide from the aqueous solution of the fusion mixture. But this method is usually tedious and requires a very thorough washing of the ferric hydroxide. Even after 5-6 washings with hot water, the ferric hydroxide retains a small quantity of sodium chromate. The following simplified method gives very good results and saves a good deal of time. The aqueous solution of the fusion mixture is acidified with sulphuric acid and diluted to 200 c.c. A portion of the solution (50 c.c.) is subjected to reduction in a Jones reductor when the dichromate is reduced to chromium sulphate and the ferric to ferrous sulphate. The reduced solution is titrated against potassium permanganate and the iron contents calculated. The iron values for sample I are also given in the table.

The following are the advantages of the present method over those that are described in the literature.

(1) The use of nickel crucible is avoided.
(2) The separation of ferric hydroxide is altogether eliminated.
(3) The method saves time.
(4) The process of fusion can be watched since it takes place in the glass test tube.

This method cannot be employed when silica has to be estimated in the chromite.

The authors wish to express their thanks to Sir J. C. Ghosh, Kt., D.Sc., F.N.I., for his keen interest in the work.

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EXTRACT OF BROOD LAC AS A SUPPLEMENTAL NUTRIENT FOR THE PRODUCTION OF ANTIBIOTICS

These studies have been inspired by the finding that corn steep liquor[1] speeds up the formation and enhances the yield of penicillin and that organic complexes are essential for stepping up the formation of steptomycin. Waksman[2] has found that an "activity factor" is essential for the formation of the antibiotic; this factor can be synthesised by *Streptomyces griseus* but its addition favours the rapid production of the antibiotic.

Extracts of brood lac, which could easily be made available in abundant quantities, have been found to constitute a rich source not only the complex organic compounds but also a good source of the members of the B-complex. The overall growth-promoting potency of these extracts has been microbiologically assayed by Mande, Mistry and Sreenivasaya.[3] It was, therefore, of interest to determine the overall efficiency of this extract as a fortifying supplement for increasing the rate of formation and the yield of penicillin and streptomycin by their respective micro-organisms.

Experiments on the formation of penicillin were carried with a medium which was composed as follows:—Sucrose 4 gms.; $NaNO_3$ 0·3 gm.; KH_2PO_4 0·1 gm.; $MgSO_4$ $7H_2O$ 0·05 gm.; $FeSO_4$ 0·001 gm.; KCl 0·05 gm.; Distilled water 50 c.c.; pH 6·8.

Aliquots of this medium (2·5 c.c.) were fortified with graded dosages of the brood lac extract (dosages based on the nitrogen content of the extract) and the total volume made up in each case to 5 ml. with distilled water. The medium was sterilised twice at 10 lbs. for 30 minutes and inoculated with a 1 ml. spore suspension in normal saline of *P. notatum* N.C.T.C. 1540 and incubated at 28° C. for seven days. Other experimental details have been described at length in our previous communications.[4] After the period of incubation, the cylinder-plate assay was carried out against a 24-hour old broth culture of *Staph. aureus* N.C.T.C. 2150 and the results are shown in the table below.

The results given in Table I show (1) that the growth of the fungus is proportional to the added amount of the supplemented lac extract; (2) at higher levels of the supplement an earlier sporulation of the fungus is included; (3) At 0·2 and 0·4 MgN levels there is a fourfold increase in the yield of penicillin as compared with the yield obtained with the unsupplemented basal medium; (4) higher concentrations of the supplement tend to lower the yield of penicillin apparently due to a toxic factor which becomes effective at higher levels of the supplement. This toxic effect has been of the supplement. This toxic effect has also been observed by Mande, Mistry and Sreenivasaya in the course of their studies.

The brood lac extract was supplemented to the basal medium used for the production of

TABLE I

Basal medium no supplement		Basal medium +0·2mgN/5 ml.	Basal medium +0·4mgN/5 ml.	Basal medium +0·6mgN/5 ml.	Basal medium +0·8mgN/5 ml.	Basal medium +1·0mgN/5 ml
Total solids per 5 ml.	0,0	4 mg	8 mg	12 mg	16 mg	20 mg
Rate of growth	++	+++	++++	+++++	++++++	++++++
Sporulation	4th day	3rd day	3rd day	2nd day	2nd day	2nd day
Initial pH	6·8	6·8	6·8	6·8	6·8	6·8
pH after 7 days of fermentation	6·2–6·4	6·4—6·6	6·2—6·4	6·0—6·2	6·0–6·2	6·0–6·2
Activity against *Staph. aureus* expressed in Oxford units ml.	3·0	11·0	11·0	9·5	9·2	6·2

TABLE II

	Basal medium—no supplement	Basal Medium +0·2mgN	Basal Medium +0·4 mgN	Basal Medium +0·6 mgN	Basal Medium +0·8 mgN
Total solids per ml.		4 mg /5 ml.	8 mg /5 ml.	12 mg./5 ml.	16 mg./5 ml.
Rate of growth	+++	+++	+++	+++	++++
Sporulation	5th day	4th day	—	3rd day	—
Initial pH	7·0	7·0	7·0	7·0	7·0
pH after 7 days of fermentation	10·2	9·8	9·8	9·8	10·4
Activity against *B. subtilis* expressed in sq. mm.	416	416	491	528	616

the Streptomycin from *Actinomyces griseus*. The composition of the basal medium is as follows:—Glucose 1·0 gm.; NaCl 0·5 gm.; Casein hydrolysate 7·32 ml. (80 mg. of total N); K_2HPO_4 0·1 gm.; Distilled water 50 ml.; pH 7·0.

This basal medium was treated with graded doses of the extract (on nitrogen content of the extract). The total volume of the medium was made up to 5 ml. with distilled water.

A uniform suspension of the spores of *Actinomyces griseus* in normal saline (1 ml.) was inoculated into the medium previously sterilised twice at 10 lbs.—30 minutes. After seven days of incubation at 28° C., a "cylinder-plate" assay was carried against *B. subtilis* to determine the activity. The results are tabulated in Table II.

It will be seen from Table II that there is little difference in rate of growth. But the day of sporulation shifts a day earlier in cases which have received higher levels of the supplement. The rise in pH is marked throughout. The increase in antibiotic activity over the unsupplemented control is 50 per cent.

Attempts at a further purification of the brood lac extract, with a view to concentrate the active factor, are under progress.

We wish to thank Sir J. C. Ghosh for his keen interest in the course of these investigations.

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March 13, 1947.

1. Moyer, A. J. and Coghill, R. D., *Chem. and Eng. News.*, 1944, **22**, 588. 2. Salman A. Waksman, *Proc. Soc. of Exptl. Biol. and Med.*, 1944, **55**, 66-69. **3.** Mande, Mistry and Sreenivasaya, *unpublished*. **4.** Ramchandra Rao, T. N., Ram Mohan, R. and Sreenivasaya, M., *Jour. Sci. Ind. Res.*, 1945, **4**, 75-76.

A NOTE ON THE OCCURRENCE OF NORITE IN JUBBULPORE

THE author records here the discovery of a new rock norite from Jubbulpore area (C.P.) by him. Norites occur on the north-east side of Jubbulpore Cantt. forming strips of black masses running N.E.-S.W. From their appearance in handspecimen they look like gabbros but their petrological analysis clearly proves beyond doubt their noritic nature.

Mineralogically they contain:—

Plagioclases (Labradorite and Andesine) up-to the extent of 40-80 per cent. These mine-

rals occur in polysynthetically twinned crystals with an extinction angle varying from 25° to 36° and 2 V = 86° for andesine and 78° for labradorite. Andesine is optically negative and labradorite positive.

Rhombic Pyroxenes (Hypersthene and Enstatite) upto 34 per cent. These minerals have straight extinction, good cleavage. Hypersthene shows marked pleochroism. The 2 V for Hypersthene = 86° and it is optically negative. Enstatite is optically positive. The pleochroic formula for Hypersthene is: X = reddish; Y = pale yellow; Z = pale green.

Monoclinic Pyroxenes (Diallage mostly) below 20 per cent. with its usual characters.

Other minerals are biotite, magnetite and a few more accessories. Their chemical analysis reveals the following points:—

Chemical Analysis of the Rock

SiO_2 ..	50·30%	MgO ..	8·74%
Al_2O_3 ..	18·32%	CaO ..	9·37%
Fe_2O_3 ..	2·76%	Na_2O ..	1·86%
FeO ..	5·56%	K_2O ..	1·90%
TiO_2 ..	trace	Water ..	1·24%

Megascopically they are more or less coarse-grained granular, hypidiomorphic and black coloured. Sp. gr. varies from 2·93 to 3·1.

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December 14, 1945.

TRACHYBASALTS FROM THE CUDDUPAH TRAPS (*PRE-CAMBRIAN*)

DURING the course of a detailed investigation of the igneous rocks associated with the Cuddupah sediments, a portion of which has already been published by the author,[1] an interesting variety of rock has been discovered near Royalcheruvu (Ananthapur District) which on examination shows extremely well-developed fluidal texture of microlites of felspar (*vide* Fig. 1). Such a rock with a definite trachytic texture had not been noticed so far from among the basic volcanic rocks of Cuddupah.

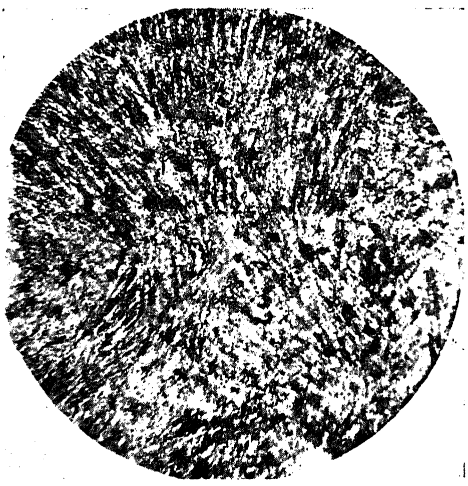

FIG. 1 × 45. Trachybasalt showing fluidal texture.

The sp. gr. of the rock is 2·9, rather much higher than the ordinary trachytes which usually show an average sp. gr. of 2·6. The rock is greenish grey in colour with a typical aphanitic appearance. Under the microscope it shows a colourless glassy groundmass with numerous microlites of felspar arranged in typical trachytic manner. Some of these show straight extinction and are, therefore, oligoclase microlites; while others, which are untwinned are orthoclase microlites. There are numerous colourless granules of augite, olivine and cubes of magnetite. A few corroded microphenocrysts of felspar with numerous inclusions have also been noticed. Though the texture is typically trachytic the rock is termed a trachybasalt on account of its high sp. gr. value and the basic character of the felspar microlites. On comparison, it is found to be almost similar to the mugearites described by Harker[2] from the Skye islands, and the trachybasalts described by W. Cambell Smith[3] from Kenya colony. The rock is being chemically analysed and the details will be published shortly.

Department of Geology,
Central College, M. R. SRINIVASA RAO.
Bangalore,
March 11, 1947.

1. Srinivasa Rao, M. R., "The composite sill of Jutoor, Cuddupah formations" *Mys. Uni. Jourl.*, 1945, **6**, 47. 2. Harker, A., *Tertiary Igneous Rocks of Skye*, 1904, 264. 3. Cambell Smith, W., "Trachytes and Phonolites from Kenya Colony." *Q.J.G.S.*, 1931, **87**, 253.

ELASTIC CONSTANTS OF ALUMS AND MIXED ALUMS

THE elastic constants of potassium alum, chromium alum and mixed alums of both of these of varying compositions by weight have been determined by using the wedge method developed in this laboratory.

Suitable single crystals have been grown from solutions and they all belong to the cubic system. 100, 110, and 111 sections of about 1 mm. thick are cut and ground; and frequencies ranging from 1 to 10 megacycles have been employed.

The following values for C_{11}, C_{12}, C_{44} in units of 10^{11} dynes/cm.^{2} are obtained in each case. Densities are determined by the author

No.	Substance	Percentage in gm. of pot. alum.	Density (gm/cm³)	C_{11}	C_{12}	C_{44}
1	Potassium alum.	100	1·760	2·56	1·07	0·86
2	Mixed alum. ..	86·5	1·772	2·52	1·05	0·81
3	Do. ..	60	1·796	2·47	1·01	0·78
4	Do. ..	54·5	1·802	2·44	1·00	0·78
5	Chromium alum	0	1·845	2·37	0·93	0·77

and compositions of the mixed alums are deduced from the linear law of densities for isomorphic crystals.

In the literature, values of C_{11}, C_{44}, and C_{14} are available from Voigt's[1] work on potassium alum; and in the above units they are respectively 2·43, 1·009, and 0·843, comparing well with the results of the present investigation.

Department of Physics,
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Waltair, R. V. G. SUNDARA RAO.
February 28, 1947.

1. Voigt, W., *Gottinger Nachrichten*, 1918-19 Heft, I. 85.

BLOOD GROUPS OF PUNJABIES AND MALDIVIANS

OPPORTUNITY was afforded during the war to examine the blood groups of 2,500 Punjabies at the I.M.H., Rawalpindi, and of 211 Maldivians at Addu Atoll.

This Atoll is the southernmost of the Maldive group of islands and the inhabitants are Singhalese in origin. A considerable inbreeding has been going on for a few centuries and the total population is less than 2,000. Therefore 211 persons were considered to be fairly representative random sample.

Vincent's technique was followed to determine the groups. The frequency distribution of different groups was as follows:—

	O	A	B	AB	A/B ratio
Punjabies ..	34·8	24·5	33·3	7·4	0·7
Maldivians ..	58·3	17·5	21·8	2·4	0·8

Field Typhus Research Dett., S. L. KALRA.
GHQ. Med. Research Organisation,
Jubbulpore,
February 17, 1947.

TURBIDITY TEMPERATURE OF OILS AS DETERMINED BY BELLIER'S TEST AND ITS SIGNIFICANCE AS AN ANALYTICAL CONSTANT

THE solubility of oils in various solvents is a constant, depending on the nature of the glycerides composing the oil. In the Valenta test, acetic acid is used as a solvent. Fryer and Weston[1] found that a mixture of equal volumes of 92 per cent. ethyl alcohol and pure amyl alcohol can also be satisfactorily employed as a solvent for turbidity value. This turbidity value is the temperature at which the solution of oil in the solvent shows the first signs of turbidity on cooling.

There are two factors which, if not allowed for, entirely destroy the reliability of the estimation of solubility in the solvents. One is free fatty acids which lower the turbidity temperature, increasing the solubility of the oils. The other is moisture, which raises the turbidity temperature, decreasing the solubility. In the Valenta test preliminary operations, *viz.*, standardization of the solvents, preparation of oils, corrections for free acidity, moisture and acetic acid, etc., have, therefore, to be carried out.

In the case of soap and commercial fatty acid analysis the original glycerides are not available and, therefore, Fryer and Weston[2] investigated the turbidity temperatures obtained with the mixed fatty acids themselves with various solvents and proposed acetic acid of 90 per cent. strength as the most suitable solvent for the purpose and standardized as in the test for oils against pure oleic acid. The presence of small amounts of undecomposed glycerides in the mixed fatty acids raises the turbidity temperature considerably; it is, therefore, essential that a complete saponification is obtained before the test is made, and the mixed fatty acids from soap or as obtained commercially, should preferably be resaponified by alcoholic potash. These authors have suggested that in addition to its value in the analysis of soap and of commercial fatty acids, the test may be applied to oil analysis. It has the advantage that no correction for acidity is necessary as in the case of oils. A further advantage offered by this method is that the result is not influenced by the presence of moisture in the oil or in the acid as in the case of the turbidity test with the oil (Valenta test).

The turbidity temperature as determined by Bellier's test is also based on the solubility factor of the mixed fatty acids of the oils in 70 per cent. alcohol under prescribed conditions and is characteristic of a particular oil. The test was subsequently modified by Mansfeld, Alder and Franz and examined by Evers[3] who found the modification satisfactory. Fryer and Weston also confirmed this in their own experience and has described it in their *Technical Handbook of Oils, Fats and Waxes* (Vol. II, p. 140). This modified test has been used by the writer for judging the purity of oils and has been found simple, rapid and fairly accurate for routine analysis as compared to the Valenta test. The results are not affected by the presence of moisture in the oil and no corrections for free acidity, etc., are required as in the Valenta test. Moreover, it can be conveniently used in the analysis of soap and commercial fatty acids and also for determining the percentages of two mixed oils, if the range between the turbidity temperatures of these two oils is fairly wide, *e.g.*, groundnut oil and sesame oil, almond oil and sesame oil, etc. Other workers[4] have also successfully used the same test for determining adulteration of groundnut oil in some edible oils and also suggested its analytical importance. Besides, the turbidity temperatures obtained with fatty acids by the method of Fryer and Weston are different from those for the respective oils, depending on the difference in the solubility of the glycerides of the oil and its fatty acids in the same solvent. If the Bellier's test is employed for the same purpose, the turbidity temperatures obtained with oils and their mixed fatty acids are nearly identical as the

glycerine that is split up from the glyceride has been found to exert no appreciable effect on the turbidity temperature. This is evident from the identical turbidity temperatures of fatty acids and glycerine (as in the case of oil) and prepared fatty acids alone (fatty acids prepared from the respective oils, *vide* Table III). Again, uniformity of solvent, *viz.*, 70 per cent. alcohol, is maintained as regards analysis of oils, soaps and fatty acids. In the Bellier's test 1 c.c. of commercial acids or those split up from soap is boiled with alcoholic potash, treated with acetic acid and the tubidity temperature is then determined. This treatment with potash in the test itself has the advantage that it ensures complete saponification of the unchanged glycerides, if any, present in the soap; and, therefore, separate treatment with potash is not necessary as in the case of Fryer and Weston method for fatty acids and soap analysis as mentioned above.

Turbidity temperatures of some common oils and fatty acids split up from oils have been observed for a number of samples of the same oil. This temperature has been found to be nearly constant for an oil. However, after examining a large number of commercial oils, it has been found that it varies within two degrees for some of the samples of the same oil. But it is more specific than other analytical constants, such as saponification value, iodine value, etc., which have a comparatively wide range. Turbidity temperatures as recorded by other workers differ; but the difference is likely due to variations in the composition of different mixed fatty acids in oils of different climatic regions. The margin of difference, however, is not so great as in the case of other analytical constants.

TABLE I

Turbidity Temperatures and Butyro-Refractometer Readings

Oil	T.T. in °C.	B.R.R. at 40°C.
Almond ..	1— 2	57·0
Olive ..	13—14	55·4
Coconut ..	12—13	35·5
Safflower ..	12—14	66·0
Nigerseed ..	22·5—25	63·0
Rape ..	22	59·5
Cotton-seed ..	21	58·5
Castor ..	— 5·0	69·0
Maize ..	21·0	59·5
Arachis ..	38—38·5	55·5

The turbidity temperature together with B.R. reading enables the chemist to judge fairly easily the purity of the oil. In the case of almond oil which is rather costly, the adulteration with olive, sesame or arachis oil can be readily detected and even ascertained as 5 to 10 per cent. of any of the adulterants raises its turbidity temperature by 6°–15° C.

The turbidity temperatures of oils and the corresponding mixed fatty acids split up from these oils and also turbidity temperatures of mixtures of two oils and the corresponding fatty acids prepared separately from these mixtures are nearly identical; as it has been found that the presence or absence of glycerine in the test has practically no effect on the turbidity temperature, which is, therefore, characteristic of free fatty acids present in the solution.

TABLE II

Oil	T.T.
Almond	1–2
,, + 5% Olive ..	6·0
,, + 10% ,, ..	8·0
,, + 5% Sesame ..	6·5
,, + 10% ,, ..	8·5
,, + 5% Arachis ..	11·0
,, + 10% ,, ..	15·0

TABLE III

Oils	T.T. of oils	T.T. of fatty acids
Groundnut ..	38–38·5	38·5
Sesame ..	15–16	16·5
Coconut ..	12–13	13·0
Almond ..	1–2	1·0
Olive ..	13–14	14·0
Groundnut 50% Sesame ,, ..	30·5	30·5
Groundnut 30% Sesame 70% ..	24·5	24·0
Groundnut 50% Coconut ,, ..	30·5	30·5
Groundnut 80% Coconut 20% ..	36·5	36·0
Groundnut 50% Almond ,, ..	30·5	30·0
Groundnut 50% Olive ,, ..	30·0	31·0

When the test is employed for a mixture of two oils the turbidity temperature of the mixture will be predominantly influenced by the oil which has a higher turbidity temperature. This is evident in the case of groundnut oil when it is adulterated with other oils such as almond, olive, sesame, nigerseed, coconut, safflower, etc. A series of experiments were carried out by taking pure samples of the above oils and mixing them with pure groundnut oil in definite percentages and determining the turbidity temperatures of the corresponding mixtures. These results have been tabulated below with the B.R. reading of pure oils.

A chart of the above results, if plotted, enables the analyst to determine the percentage of adulteration with groundnut oil in various oils nearly accurately. The procedure can be conveniently followed in the case of other oils by plotting such charts of turbidity tempera-

TABLE IV

A	B				
Per cent. of Groundnut oil B. R. Reading .. 55·5	Turbidity temperature of the oil mixture containing the percentage of groundnut oil shown in column A and the oil mentioned below to make up the balance				
T.T.	Coconut BR. 35·5	Nigerseed BRR. 63·0	Saffiower BRR. 66·0	Almond BR. 57·0	Olive B.R.R. 55·4
Pure oil, 38 —38·5	12—13	22·5—25	12—14	1—2	13—14
Gr. 10%	16·0	26·0	18·5	15·0	17·5
,, 20%	20·0	28·0	22·5	20·0	21·0
,, 30%	21·0	29·5	27·0	25·0	24·0
,, 40%	27·5	31·0	30·0	28·0	27·0
,, 50%	30·5	32·5	32·0	30·5	30·0
,, 60%	32·5	34·0	33·5	32·5	32·0
,, 70%	34·5	35·5	35·0	34·5	34·0
,, 80%	36·5	36·5	36·5	36·0	36·0
,, 90%	37·5	37·5	37·5	37·5	37·5

tures of any two oils mixed in definite proportion.

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February 23, 1947. C. M. DESAI.

1. Fryer and Weston, *Analyst*, 1918, **43**, 4-20. 2. —, *Technical Handbook of Oils, Fats and Waxes*, 2, 302-303. 3. Evers, *Analyst*, 1912, **37**, 487. 4. Hawley, H. *Curr. Sci.*, 1937, 640; Desai, C. M., and Patel, A. H., *Ibid.*, **1945**, **37**, 130; Narayanier, S., *Ibid.*, 1945, 177.

A METHOD OF SEALING TUBES OF FUNGAL CULTURES TO INCREASE THEIR LONGEVITY

MAINTENANCE of fungi on nutrient media involves frequent transfers, as the medium soon loses its water contents and becomes dry, especially under the dry and hot climatic conditions of Delhi. Several attempts were made to modify the standard method so as to check the quick-drying of the nutrient agar medium and thus to reduce the frequency of subculturing. It was realised that if the mouth of the culture tube were closed some other way than by the usual cotton-wool plug so that the hot and dry atmosphere of the room in which the cultures are stored did not affect the agar medium inside the tube it would remain moist for a longer period. A substitute was ultimately found in a combination of cellophane and paraffin wax. The fungi in culture tubes thus sealed have been found to remain viable for at least eight months (Fig. 3), and the transfers made grew true to type. The growth of the fungus in sealed tube was seen to have been checked but when at the end of eight months the seal was replaced by the usual sterilised cotton-wool plug the fungus resumed its growth. In parallel sets of cultures maintained in tubes either plugged with cotton-wool or sealed with cellophane the media had completely dried and had become brittle and membranous (Figs. 1, 2), the fungi in these tubes were no more viable. For these trials the following fungi were used:

FIGS. 1–3. Cultures of *Polystictus hirsutus* (Wulf) Fr. subcultured on 19-3-46 on Potato Dextrose agar; photographed on 19-11-46.

FIG. 1. Culture tube plugged with cotton wool.

FIG. 2. Culture tube sealed with cellophane.

FIG. 3. Culture tube sealed with cellophane and paraffin wax.

Macrophomina phaseoli (Moulb.) Ashby, *Penicillium notatum* Westl., *Melonopsichium eleusinis* Mundkur and Thirumalachar, *Saccharomyces cerevisiœ* Hansen, *Trichoderma viride* Pers. ex Fr., *Polystictus hirsutus* (Wulf.) Fr., *Fusarium fructigenum* Fr., *Alternaria solani* (Ell. et Mart.) J. et Gr.

For this method of sealing pieces of cellophane are cut to the required size; they should be big enough to go over the mouth of the culture tube and to cover a part of the wall of the tube. They are sterilized with alcohol and stored in sterilized petri-dishes. For fixing these pieces to the tube a water solution of 15 per cent. gelatine and two per cent. copper sulphate is used. This solution is kept in a covered container like a petri-dish. The required sub-culture is made in the usual way on a standard medium like P.D.A. and the tube is plugged with cotton-wool; when the culture is well-grown in about a week's time the cotton-wool plug is removed under aseptic conditions, the mouth of the tube is immediately dipped for a few seconds in the gelatine solution. The mouth of the tube is then placed vertically on a piece of sterilized cellophane paper; the free ends of the cellophane are then pressed down the sides of the tube; when the gelatine has set a good seal has been formed; the mouth of the tube is then dipped into hot melted paraffin so that the cellophane paper is covered with wax; the whole process of sealing the tube in this way can be performed in fifteen seconds.

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January 28, 1947.

A CASE OF POLYEMBRYONY IN *POIVREA COCCINEA* DC.

(=*Combretum coccineum* Lamk.)

THE development of the embryo of *Poivrea coccinea* has been found to take place according to the Asterad type. Usually only one embryo is developed in each ovule. In a single case, however, two embryos have been found to be formed (Fig. 1). One of the embryos is developed from the fertilised egg. The other one is near it. Judging from the position it is possible that it is developed from either one of the synergids or from a cell of the nucellus

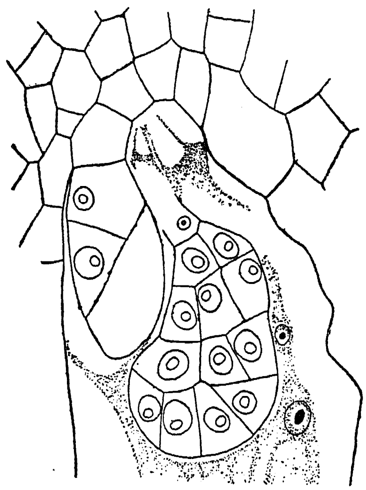

FIG. 1. *Poivrea coccinea.* L. S. of the micropylar part of the embryo-sac with the nucellar cells above it showing two embryos in the embryo-sac, × 215.

abutting on the micropylar end of the embryo-sac. In this plant, however, the synergids are observed to persist until a late stage of the development of the proembryo. The apical parts of the synergids are clearly seen in the preparation (Fig. 1). Hence the extra embryo seems to have been developed from a nucellar cell.

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February 15, 1947.

SYNTHETIC PENICILLIN

THE announcement that American research workers have recently isolated a specimen of synthetic penicillin has led to reports that synthetic penicillin, will very shortly be cheaply and plentifully available. Such reports are, however, based on a misunderstanding of the nature of the synthesis achieved. The work has been done by Dr. Vincent du Vigneaud and his research team at the Cornell University Medical School, New York, and is described in *Science* (Vol. 104, 1946, pp. 431-33). They found that the product of reaction between two decomposition products of penicillin-*d*-penicillamine and 2-benzyl-4-methoxymethelene-5 (4)-oxazolone possessed slight antibacterial activity. Assay showed, however, that the yield of penicillin was less than 0·1 per cent. A similar result was recorded by Oxford workers in 1942; they demonstrated that the activity of the product was due to penicillin by inactivating it with the highly selective enzyme, penicillinase. In view of the very low yield, however, the reaction was not further investigated at Oxford.

Starting with this very impure reaction product, du Vigneaud and his colleagues obtained, by a laborious extraction process, about 8 milligrammes of crystalline synthetic penicillin G. The course of the reaction and purification was followed by replacing some of the ordinary sulphur atoms in the penicillamine by a radioactive sulphur isotope which could be detected by Geiger counters. The work is of considerable theoretical interest and a fine example of skilful chemical research, but it is of no commercial importance because the starting materials themselves are difficult and costly to synthesise, the yield is tiny and the purification process very time-consuming. Difficult though it is, however, the method may be valuable for preparing, for experimental purposes, varieties of penicillin other than those known to be produced by the mould.

—(Courtesy of *Discovery*, 8, No. 2, Feb. 1947.)

REVIEWS

Crop Production and Enviroonment. By R. O. Whyte. (Faber & Faber, London), 1946. Pp. 372. Price 25*sh.*

The ultimate aim of all botanical research is to so control and direct the behaviour of plants as to get the maximum benefit out of them. Several of the practices followed by farmers and horticulturists are based on developmental physiology although they have been evolved by long experience without an appreciation of the scientific principles involved. The work of the plant physiologists has been concerned with the most detailed possible objective description and interpretation of phenomena occurring in living organisms, and among the attempts to actually control the phenomena by subjecting their progress to the will of man, the discovery of the Russian botanist, Lysenko, might be considered the most important in recent times. This discovery known as 'Vernalization' or pretreatment of activated seed has been exploited with enthusiasm and great expectations all over the world, and considerable amount of literature has appeared on the subject. The present book has brought together "all the available scientific evidence and practical experience in order to show how and when crops react to environment and to indicate how this nature of reaction affects crop yields, distribution and general agronomic behaviour and techniques". A critical review of the earlier investigations which had formed the background for Lysenko's discovery forms part of the book. The earlier enthusiasm for vernalization as such has perhaps cooled down, and India is the only country outside U.S.S.R. that is still taking an acive interest in pretreatment of seeds in various crops. The book should, therefore, be specially welcome to biological workers in India.

The first few chapters of the twenty contained in the book deal with growth and development, the distinction between which must now be familiar to those acquainted with vernalization literature, and the effect of environment like heat, light and darkness on these two phases. It is now recognised that every plant has its own specific requirements of temperature and light in the presence of which it proceeds to reproduction. The work of Gregory and his associates at the Imperial College, London, has led to a better understanding of the biological processes involved in vernalization and it has also established that Lysenko's postulates about the sequence of distinct phases and nonreversibility of the development process are untenable. Every physiologist is familiar with the pioneering work of Garner and Allard on photoperiodic reactions and their division of crops into short-day and long-day plants. Later work in America and Russia is indicating that it is darkness and not the photo-period which activates development in short-day plants, and that it is not the magnitude of the proportion between daily darkness and light but the absolute length of the dark period which is important. Recent researches have also shown that the visible phase or stage of the formation of male and female gametes has environmental requirements of light, and probably also temperature, that differ from those which govern flowering of the plant. Valuable information has also become available on pollen viability in relation to the influence of heat and light.

Three of the chapters in the book deal with the location of response to vernalization and the action of hormones. The critical work at the Imperial College, London, has shown that the seat of response is the embryo and not the endosperm as was believed earlier. All investigations appear to indicate that the responses associated with the photo-periodic reaction are transmitted from one part of a plant to another by means of a substance of a hormonal nature. It is claimed that the hormone or hormones can even pass from one plant to another through a non-living diffusion contact. Even names like florigen and vernalin have been proposed for these hormones but it is not possible to draw any conclusions as they have not yet been identified.

Though investigations on plant physiology and metabolism at different developmental phases or when exposed to controlled environmental factors have not yet reached a stage warranting definite conclusions, the scattered results give an indication of the possible application of the results to the production of optimal yields, either grain or forage, and to the optimal utilization of fertilizers and other cultural measures. Comparing plants raised from vernalized and unvernalized seeds, it is found that while the intensity of photosynthesis is not affected by vernalization, the leaf area, the factor most closely connected with yield, is markedly affected by vernalization. Results of various experiments in cereals are given to show the scope for higher yields by seed treatment. In spite of the large amount of experimentation the practice of vernalization has not been taken up anywhere outside U.S.S.R., not even in Canada and N. America, where it should have been particularly valuable for extending the cultivation in the northern regions. The choice of suitable varieties or breeding special varieties is, however, widely practised and any necessary manipulation of growth or development has been resorted to by adjustments in agronomic practices.

The subject of resistance to adverse environment like cold, heat, drought, exposure to pests and diseases, etc., as related to developmental physiology, is dealt with in a chapter. One interesting phenomenon recorded in several crop plants is the occurrence of maximal infection by fungus diseases and insect pests

at a time when the part attacked has reached a peak in nutritive value or protein content. In most cases breeding and agronomic management offer the only practical means of avoiding damage. .

The chapter on Crop Production and Geographical Distribution deals with the question of general application of experimental results in agricultural and horticultural practices. The most important factors as regards true development of crop plants are the seasonal and daily trends and the length of the daily period of light and darkness. The results of various experiments do suggest that it is possible to find and isolate strains with different critical day-lengths suitable for growing under appropriate conditions. Attention is drawn to the results often obtained by breeders, namely, that the habit of a strain in one environment is not predictable from its mode of growth in another, and that genotypic differences not apparent in one environment may be revealed in another. The close alliance of basic research to practical objectives is exemplified in the location of the new production of sugarbeet seed in U.S.A. making the country independent of the seed supply from Europe.

The review on the gentical aspects of the general problem of developmental physiology is the one that has aroused acute controversy between the Russian school, supporter of phasic development, and the school of formal mendelian genetics. The subject has been very ably dealt with by Hudson and Richens in a recent Agricultural Bureau publication entitled *Soviet Genetics.* The criticism about the inheritance studies of morphological expressions of a physiological condition, for example, earliness and lateness, on the basis of genes is not justifiable for the reason that practical and useful results have come out of such studies in India with special reference to rice. It is doubtful if the behaviour of the time-limited and season-limited rices grown in different parts of India could be satisfactorily explained on the basis of phasic development. It is not clear from the perusal of the publication *Soviet Genetics* if the Russian method of breeding on the basis of length of developmental phase has produced any outstanding results.

The last four chapters of the book which discuss all the results of experiments on the developmental physiology of various representative crops conducted since 1935, contain valuable information of practical importance. The chief crops dealt with are cereals (wheat, oats and barley), sugarcane, grain and fodder legumes, sugar-beet, potatoes, herbage plants and vegetables. There is also included a useful summary in a tabular form of results obtained in Ithaca, New York, on the optimal requirements of heat and light for a whole range of florist crops. The results on tropical and sub-tropical crops are dealt with under rice, wheat, mustard, gram, crotolaria, etc. In concluding the author pays a compliment to Indian workers and says that while the work at the Imperial College, London, may be expected to provide additional knowledge on the fundamental biological processes associated with vernalization, the work in India might provide data to fully assess the practical application of the methods of pre-treatment of crops by temperature or light. It is surprising that the considerable volume of useful work done in India on cotton, with special reference to environment, has escaped the attention of the author.

There is no doubt that the book should prove an invaluable addition to the library of all biological workers. It contains practically all the available information on a subject of research a little over two decades old. In addition to several useful illustrations and charts reproduced from their original publications, there is an exhaustive bibliography given in the end. The author who has already to his credit several useful publications of the Imperial Agricultural Bureau can well be congratulated on this production. There is, however, one defect, if it can be considered a defect, namely, the repetition of information, but this was perhaps unavoidable in the plan he has adopted to deal with the extensive data.

K. R.

Caste in India. Its Nature, Function, and Origins. By J. H. Hutton, C.I.E., M.A., D.Sc. (Cambridge University Press), 1946. Pp. 279. Price 18*sh*. net.

When at the present day, Mr. Gandhi has been persistently declaring, in season and out of season, that a caste-less and class-less India alone can afford to exist as an independent political entity, it is bound to be interesting and withal intriguing to note that what seems to me to be the most rational and scientific vindication of the caste-system proceeds from Dr. Hutton, Professor of Social Anthropology in the University of Cambridge, who, in the course of the volume under notice, has undertaken within a comparatively short compass, a masterly analysis of the conditions and circumstances responsible for the origin of the Caste system and of those responsible for conferment on the said system scientific and sociological validity and sanction. In the brief "Foreword", Dr. Hutton explains in reference to the 5,000 and odd works computed to exist by an American Indologist on the subject of *Caste*, that he has made an endeavour in a comparatively new direction not merely to examine the origins of the caste-system but also to determine its place in the social, and economic structure of Hinduism and Hindusthan.

The work stands divided into *four* Parts. In the first entitled "The Background", which contains *four* chapters, Dr. Hutton has attempted a preliminary clarification of concepts relating to the origin, development, sociological and pragmatic sanctions of Caste-system as it is actually found in Southern India (Chap. 2), Western, Central and Eastern India (Chap. 3) and "Northern India" (Chap. 4). In the "Introductory" chapter, it is pointed out that geographical circumstances have imposed unity on the peoples of this vast sub-continent. At the same time, diverse and different origins of peoples have emphasized variety and multiplicity. The thesis is argued that it is the caste-system that has made it possible for harmonization of apparently irreconcilable requirements of geographical unity and variety of origins within a single social system which historically has been demonstrated to have been a stable one.

The *second* Part which also contains *four* chapters is devoted to an exposition and critical discussion of the "Structure", "Strictures", "Sanctions" and the "Functions" of the Caste-system, each topic getting a chapter.

The *third* Part arranged again into *four* chapters, contains an exhaustive examination of the "Origins" of the Caste-system with special reference to traditional accounts of indigenous and intrinsic origins, similar and analogous systems and institutions found elsewhere, and other theories advanced by Indologists and Comparative Sociologists.

The *fourth* Part contains two valuable "appendices", one on "The position of Exterior castes", and the other on "Hinduism in its relation to primitive religions of India" both of which have been reproduced with slight alterations verbal and punctuational in character from Dr. Hutton's *Report on the Census of India* (1931).

The *fifth* Part is made up of an exhaustive "Bibliography", "Glossary" and an "Index" which form the inseparable constituents of paraphernalia of modern publications, edited and planned on lines of scientific and critical investigation.

From the fore-sketched necessarily brief but, fairly exhaustive summary of the main features and contents of Dr. Hutton's work, it must be admitted that the author has been eminently successful in his able attempt to place the much-maligned system of caste in the focus of and proper perspective of sociological and anthropological consciousness, and I would particularly commend the author's judgment that "Indian society has survived a vast number of invasions, revolutions ... conquests ... this is largely due to the caste system ..." (p. 106) to the familiar type or pattern of the ultra-radicals and reformists who have been loudly proclaiming that the ills and troubles confronting the Indian nation directly spring from the accursed caste-system.

In the light of the latest and modernest pieces of legislative enactments such as the Laws relating to validation of *Sagotra*-unions, divorces, etc., Dr. Hutton's volume may be in a sense regarded as an anachronism, but, it would be impossible not to admit that the author has presented the problem of caste in an exceedingly understanding and penetrating manner purely from the standpoint of a disinterested student pursuing the modern scientific and critical methodology.

Dr. Hutton's volume illustrates in an illuminating manner some of the difficulties inseparable from attempts made by foreigners to understand the intricacies of the Sanskrit language. I shall just refer to some. (1) The term *Pravara* (pp. 50-53) printed with amusing and outlandish diacritical marks suggests a meaning quite different from that sanctioned by the context. (2) Likewise, the term *Satapatha* is severely man-handled (p. 258). (3) In the language of the *Gita*, the caste system has been definitely CREATED and brought into being by the Supreme Creator (*"Chatur-varnyam-maya-srishtam"*, Chaps. 4-13). So, it is not quite correct to speak of the system as established by divine ordinance or divine approval. (4) The term *Dharmeswar* is done into "The Righteous one" with interrogation mark on p. 164—and without it on p. 109. The correct rendering would be the Lord or Controller of a spiritual and moral order. These and similar instances have not been covered by the explanation attempted in the "Foreword" of "certain inconsistencies". In the "Foreword", the author has made a confession of his weakness or partiality for the fluctuating use of singular and the plural verbs when the nominative happens to be CASTE. Making the duest allowance for his partiality, I slur over the usage, but, it must be passing strange that a singular verb should have been used when the subject stands in plural (not in reference to the dubious term *caste* however). Thus, you read on p. 95, "Purification and expiation IS followed by ..." But none of these would adversely affect the uniform excellence of Dr. Hutton's work on which he deserves to be unreservedly felicitated.

R. Naga Raja Sarma.

HORIZONS OF BIOCHEMICAL THOUGHT

Currents in Biochemical Research. Edited by David E. Green. (Interscience Publishers, Inc., New York), 1946. Pp. 8 + 486. Price \$5.00.

The science of biochemistry has proundly directed and fertilised the progress of many other branches of scientific enquiry. It has enriched general biology, chemistry, pharmacology, chemotherapy, medicine, agriculture, nutrition and public health; more recently, biochemical science has invaded the field of genetics, which has resulted in the birth of *Biochemical genetics*, a branch of science which has already shown great promise of a bright and fruitful future. Biochemical science whose principles and techniques are so extensively invoked for the ever-increasing development and specialisation of other branches of scientific research, has been, in consequence, expanding at a terrific rate as can be gathered from even a casual perusal of the scientific literature. The imperative need, therefore, for a survey of the field with a view "to get at the simple essential concepts which are basic to their apreciation" has been generally felt.

Currents in Biochemical Research represents a unique venture in the successful presentation of this survey and in the satisfactory fulfilment of this need. In accomplishing this difficult task, Editor Green has been fortunate in securing the co-operation of the foremost authorities in their respective fields. To quote the prefatory words of the Editor, the volume "represents an attempt by some thirty research workers to describe in as simple language as possible the important developments in their own fields and to speculate a little on the most likely paths of future progress". The most important portion of the volume consists in the exciting glimpses into fascinating horizons of biochemical thought, to which the reader is introduced; not less interesting and valuable are the future trends and applications of biochemical research and experimental technique both of which tend to inspire new and expanding lines of work, and provoke fresh ideas of approach to old problems.

The thirty-one essays which comprise the volume cover a wide field, biochemical genetics, viruses, photosynthesis, plant biochemistry, vitamin research, nutrition, enzymes, intermediary metabolism, heterotropic assimilation of carbon dioxide, Isotope technique, plant and animal hormones, Immunochemistry and Chemotherapy. The two last chapters, one on Social aspects of nutrition and the other on Organisation and support of science in the United States, have a general interest. The volume is unique in its conception and exceptionally brilliant in its execution. It will command a wide circle of readers interested in the pure and applied aspects of biochemical science, and will be received by everyone of them with enthusiasm and gratitude.

Marine Microbiology. By Claude E. ZoBell. (Chronica Botanica Co., Waltham, Mass.; and Macmillan & Co., Ltd., Calcutta), 1946. Pp. xv + 240. Price $5.00.

Micro-organisms play a fundamental and vital role in determining the marine environment; they are the dynamic agents which are intimately associated with the cycles of carbon, nitrogen, phosphorus and sulphur. They actively participate in the geological transformations and in the formation of deposits at the bottoms of the seas. In addition, their biochemical activities have a practical bearing on the fouling of the bottoms of ships and on the corrosion of iron and other metals. Exclusive types of micro-organisms are to be found in the sea by virtue of the fact that it represents a specialised type of environment with a high salinity. These marine organisms may, therefore, be expected to exhibit exceptionally distinctive biochemical functions yet undiscovered; they offer to the biochemist, in consequence, an unexplored and virgin field of research.

Marine micro-organisms have been traced to be directly or indirectly responsible for the formation of gases in the sediments of seas, for the conversion of organic matter into petroleum or proto-petroleum and for the deposition of sulphur. The gypsum type of sulphur deposits are believed to have resulted from the microbiological reduction of calcium sulphate associated with marine sediments. The author puts forth a significant suggestion that "Calcium sulphate is being reduced to sulphur at the expense of the buried organic matter which surves as a source of energy for microbial action." Continuing he adds, "Although conclusive proof is still lacking, it is generally believed by geologists and microbiologists that anaerobic bacteria are responsible for sulfur deposits of the gypsum type. Some of these sulfur deposits in Louisiana and Texas are a hundred or more feet thick. Unique sulfate-reducing bacteria, which appear to be indigenous species, have been isolated from sulfur-limestone-anhydrite formations from a depth of 1,550 feet. Hunt attributed the origin of the sulfur deposits of Sicily to the bacterial reduction of sulfates in ancient shallow marine seas resembling present conditions in the Black Sea."

More recently, deposits of sulphur have been discovered in the coastal areas bordering the Bay of Bengal; these deposits which are confined to the first three feet from the surface have been shown to be due to the action of bacteria which function in a salinity of 10-12 per cent. The subject of marine microbiology is thus one of great practical interest and also one of great theoretical significance.

The author has rendered a great service to the science of marine microbiology by presenting to all the interested investigators a comprehensive, logically arranged and well-documented account of the present status of the problems pertaining to marine microbiology. This volume will remain for a considerable time to come not only an illuminating compendium of reference but also a source of inspiration to all those interested in the development of this fascinating branch of microbiology.

Antibiotics Parts I and II. By Werner W. Duemling and others. Edited by Roy Waldo Miner. (*Annals of the New York Academy of Sciences, New York*, Vol. 48), 1946. Pp. 31-218.

The New York Academy of Sciences has recently been publishing in its *Annals* a series of valuable records of Symposia held under its auspices, on subjects of topical interest and scientific value. These records contain critical reviews of thoughtfully selected subjects, indicate future lines of development and focus the attention of interested investigators on problems which await solution. The participants in the Symposium on Antibiotics are scientific celebrities in their respective fields and, therefore, entitled to speak with authority on the aspects of the subject which they have chosen to expound.

The present number of the *Annals* on Antibiotics is presented in two parts: (1) Microbiological and (2) Pharmacological. S. A. Waksman has spoken of the contribution of the microbiologist in discovering and developing antibiotic substances. The history of the development of penicillin production is closely associated with the wartime endeavour to produce regardless of cost an effective antibiotic for controlling certain important diseases of man. It was fortunate that penicillin production was undertaken as one of the wartime projects; research on antibiotics was generously financed and the industry was liberally subsidised. What was the result?

To quote Waksman, "The yield of penicillin in the medium, as a result of the growth of the fungus *Penicillium notatum*, was increased from 2-4 Oxford units per milliliter to 200 and 1,000 units per milliliter. New and very active strains of the penicillin-producing fungi were isolated. Finally, the deep or submerged method for the production of penicillin on a large practical scale was developed. Penicillin was isolated, crystallised, and its chemical nature determined. This remarkable development in the production of penicillin has, finally, led to a rapid rise in the use, on a scale never dreamed of even three or four years ago."

Vigorous search for other antibiotics particularly specific towards gram-negative pathogens led to the development of streptomycin.

Penicillin production became an economic reality thanks to the development of improved

penicillin-producing molds. This aspect of the problem has been presented by Kenneth B. Raper of the Northern Research Laboratory, Illinois. Biochemical aspects of penicillin-producing moulds have been discussed by M. J. Johnson of the University of Wisconsin; a comparative study of the metabolic changes accompanying the tray and tank fermentations, has been made. An article on the production of antibiotic substances by actinomycetes has been contributed by S. A. Waksman himself who is responsible for discovering streptomycin.

The second part of the volume is devoted to a discussion of the pharmacological aspects of antibiotics. Those interested in antibiotics will find in this volume a clear and authoritative exposition of the various aspects of the problem of antibiotics.

Amino Acid Analysis of Proteins. By William H. Stein and others. Edited by Roy Waldo Miner. (*Annals of the New York Academy of Sciences, New York*, Vol. 47), 1946. Pp. 57-240.

Progress in any branch of science is often arrested on an account of certain difficulties inherent to the subject and remains at a stage of disheartening stagnation until a new method of approach is discovered or a new experimental tool of research is forged. Advances in the chemistry of proteins have for some time been rather slow but during the last few years, the analytical approach to the study of proteins has been perfected with a precision which is truly astonishing.

The present number of the *Annals* represents an invaluable contribution to the subject of amino acid analysis of proteins; these methods of analysis, applicable as they have been shown to be to micro-quantities of proteins, have already played a fundamental part in giving us an accurate and complete picture of the amino acid make up of many important groups of proteins. Of particular interest and of essential importance are the two methods of isotope dilution and the more simple but equally accurate and highly specific microbiological method of estimating amino acids.

The advantages of the microbiological methods are beautifully summarised by Hans T. Clarke in the concluding portion of the volume. "Their specificity is high, they are applicable to fantastically small amounts, and their precision is astonishingly great, particularly in view of the uncertainty which always attaches to procedures involving living systems. Although it seems unlikely that they will soon be placed upon a theoretical basis, a brilliant future can safely be predicted for these methods."

Referring to the isotope dilution method, the same author says, "The isotope dilution method, which, theoretically, should yield results of particular value as absolute standards of reference for testing the validity of other analytical procedures, can at present be carried out only in the few laboratories in which a mass spectrometer is operated. If isotope analytical services, available to any research worker, are organised, the isotope dilution methods will become more generally useful."

Those interested in the composition and empirical formulæ of proteins will find the article on "Amino acid composition of simple proteins" extremely illuminating. Thanks to the accurate methods of analysis; it has been possible to determine the amino acid made up of a number of crystalline, homogeneous and integrally pure proteins, *e.g.*, lactoglobulin and insulin and arrive at an empirical formulæ in terms of its amino acid residues. This represents a fundamentally important advance, which has been rendered possible through the analytical approach.

The volume which is well documented with all important references to literature, will be warmly welcomed and widely read by every one interested in the advancement of protein chemistry.

DECENTRALISATION OF INDUSTRIES AND PREVENTION OF WARS

ADDRESSING the scientific workers of the Indian Institute of Science, Acharya J. B. Kripalani, President, Indian National Congress, invited the attention of the audience, to the misuse of the discoveries and inventions of science by political adventurers and dictators, who lacked a moral and humanitarian background. Knowledge is power and the possession of power without the restraining capacity to regulate its use in a moral and discriminating way will only lead to terribly disastrous consequences. There was a period when we might have been able to eliminate wars. The nineteenth century idealists dreamt that such a period was near at hand. But scientific research helped to perfect instruments of destruction and rendered warfare far more terrible and destructive. Scientists could not shirk their responsibility in this matter.

Proceeding, Acharya Kripalani declared, "But science has come to stay; we have to face it and its consequences." He asked, "Can not science so devise means and methods that industries which are so heavily centralised, are decentralised?" If industries are decentralised, wars will, at least not be mechanised to the extent they are. Scientists can help to decentrlise industries and introduce into the villages specially designed small machines powered by flexible eletric power, and thus contribute to an eradication of most of the evils flowing from centralisation. These small machines can only make what they are intended to and would not lend themselves to be converted ovrnight for the manufacture of the modern weapons of war.

"My appeal to you as scientists is this. Let us make the world a simpler place to live in. Please forget that science should conquer Nature. Nature is a terrible force and it will have its own revenge. Let your aim be to co-operate with, and not conquer Nature. Work 'with' nature. Fabricate small machines which the villager and his family can work at home with electric power and thereby help to decentralise industries."

SCIENCE NOTES AND NEWS

ANTHROPOLOGICAL SURVEY OF INDIA—5-YEAR DEVELOPMENT SCHEME

A scheme for the development of the Anthropological Survey of India was approved by the Standing Finance Committee which met in New Delhi recently under the Chairmanship of the Hon'ble Mr. Liaquat Ali Khan, Finance Member.

The five-year scheme for the organisation and development of the Anthropological Survey of India was prepared at the request of the Government of India by Dr. B. S. Guha, now Director of Anthropological Survey of India, and Col. R. B. Seymour Sewell, of Cambridge University, and lately Director of the Zoological Survey of India. It was accepted in principle by the Government of India last year.

The scheme includes the establishment of a Bureau of Anthropology. The greatest importance of the lines of work to be adopted by the Bureau lies in the effect that the study of Anthropology and the dissemination of a knowledge of the various races and tribes that form the population of India can have on the unifying and gradual welding of the variegated and diverse components into a unified whole. Such an effect, it is pointed out, has already been fully exemplified by the result achieved in the U.S.S.R., where a conglomeration of tribes and races of diverse languages, origin and customs has been welded together into a single unified nation.

The impending changes in the social and administrative services in India will, it is also considered, require expert guidance from a properly developed Anthropological Survey Department, if India is to assimilate about 25 million of the aboriginal and tribal people in a healthy manner into her general system.

The Government of India have already set up a nucleus of the Anthropological Survey of India and an expenditure of Rs. 1,37,730 was provided to meet expenditure during 1946-47. During 1947-48, the second year of the plan, expenditure is estimated to be Rs. 3,62,000. During the years 1948-49 to 1950-51, an expenditure of about Rs. 10 lakhs is estimated. It is proposed to shift the Anthropological Survey of India, which is now situated in Benares, to the Indian Museum at Calcutta where it has been possible to obtain some additional accommodation for it.

URANIUM UNIT OF THE GEOLOGICAL SURVEY

A plan with regard to the uranium and thorium deposits discovered in India will be worked out by the Atomic Research Committee and a Uranium Unit under the Geological Survey of India. The former organisation has already been formed under the chairmanship of Prof. H. J. Bhabha, while the latter is under contemplation and will be in charge of Dr. M. S. Krishnan, when formed.

So far as British India is concerned, the export of uranium, monazite and thorium is at present controlled under the Commerce Department's Export Control Notifications which will continue in force upto March 25, 1946. He indicated also that steps to prevent foreign exploitation of these deposits, including legislative measures if necessary, were under consideration.

There have been small occasional finds of specimens of uranium-bearing minerals from the Abraki Pahar Mica Mines and from Pichhli in the Gaya District, from Sungri in Singhbhum District, from the Sankara and Kodandarama Mica Mines, and from Tummalatalupur in the Nellore District, from near Vayampatti in the Trichinopoly District, from Yedur in Mysore, from Thadagay Hill in Travancore and from Bisundni in Ajmer-Merwara.

Monazite, one of the thorium bearing minerals, occur in the Beach Sands in Travancore State and in the coastal areas of the Madras Presidency and Orissa.

CORRESPONDENCE WITH GERMANY

Indian scientists will be gratified to learn that steps have been taken by the Government of India to permit resumption of commercial, financial and other correspondence with persons and firms in Germany subject to the condition that such correspondence is conducted through unregistered letters up to 1 oz in weight and non-illustrated postcards. Unregistered packets containing newspapers, magazines and periodicals up to 1 lb in weight may be sent to the British Zone and the British Sector of Berlin only.

TWO UNITED NATIONS SCHOLARSHIPS FOR INDIAN STUDENTS

The Purdue University, Lafayette, U.S.A., has offered to Indian students two United Nations Scholarships each of the value of 130 dollars per term tenable at the University for study in Science, Engineering, Agriculture, Pharmacy and Education for the term beginning in September 1947.

The scholarships will be granted for one term in the first instance but can be extended a term at a time till the completion of the course provided the scholars make satisfactory progress. Candidates must be graduates of Indian Universities and should be able to supplement the scholarship from their own funds in order to meet the high cost of University education in the U.S.A. They should be prepared to spend about 2,500 dollars from their own pockets.

The Government of India have invited Universities and other Educational Institutions of similar rank to recommend names of suitable students. The final selection will be made by the authorities of the Purdue University.

GOVERNING BODY FOR DELHI POLYTECHNIC

With a view to developing the Delhi Polytechnic into a first class Technological Institution, a Governing Body has been set up under the Chairmanship of Mr. S. Lall, Secretary to the Government of India, Department of Labour. Besides the local industrial and other interests, the Delhi University and the local centre of the Institution of Engineers (India) are also represented on this Body, which will perform both advisory and governing functions. An officer of the Education Department will act as Secretary to the Governing Body.

THE ENTOMOLOGICAL SOCIETY OF INDIA

At the 9th Annual Meeting of the Entomological Society of India, held on 6th January 1947 at Delhi, Dr. K. B. Lal and Dr. K. D. Baweja were eletced President and Secretary respectively.

SIX NATIONAL LABORATORIES

An expenditure of nearly 90 lakhs of rupees for the erection and equipment of the six National Laboratories for Physical, Chemical, Metallurgical, Fuel, Glass and Road Research for the year 1947-48 was approved by the Governing Body of the Council of Scientific and Industrial Research, India, on the 9th February 1947.

GRANT FOR THE RAMAN RESEARCH INSTITUTE

The Governing Body of the Council of Scientific and Industrial Research, India, decided that subject to funds being obtained from the Central Government, a capital grant of Rs. 3 lakhs should be made to the Raman Research Institute of the Indian Academy of Sciences, Bangalore.

HONOURS AND AWARDS

Prof. M. N. Saha has been elected a member of the Astronomical Society, America, and Sir S. S. Bhatnagar has been awarded the Sir C. R. Reddy National Prize in Chemistry.

EXHIBITION OF INDIAN PATENTS

The Exhibition, which has been organised in memory of the late Jamshedjee Tata, is intended to stimulate Indian talent and enterprise to develop the resources of the country. It is proposed to have in the Museum a permanent section for Patents, which may ultimately develop into a Patent Museum.

In his inaugural address, Dewan Bahadur K. Rama Pai, Controller of Patents and Designs, stressed the usefulness of the Exhibition in providing an incentive to inventors and patentees for giving practical effect to many of their ideas. He regretted that Indian inventors were not aware of the proper channel through which their inventions could be adopted for industrial purposes. It was a sad fact, he said, that while 90 per cent. of the applications for patents filed in India during 1946 came from aliens, only 10 per cent. were from Indians. It was, therefore, necessary, he maintained, that the Patent System should receive greater attention in all responsible quarters in the country.

Warning that industrialists should not be hasty when judging the value of the inventions exhibited, Mr. Pai narrated the episode of Alexander Graham Bell (with whose birthday the inauguration of the present Exhibition coincided) at the Philadelphia Exhibition where his invention of the telephone went very nearly unnoticed until the Emperor of Brazil recognized him and appreciated his 'talking box'. He also related Bell's adventures with Mark Twain who refused to invest a small amount in telephone stock and thus lost a fortune. Even the Patent Office, Mr. Pai continued, was sometimes not able to estimate the possibilities of new inventions. While the 1921 Annual Report of the Patent Office had only a sceptical reference to the invention of a pocket *charka*, he had seen in the present day very efficient *charkas* which could be clipped on to the vest pocket like a fountain pen.

Finally, he expressed the hope that the Exhibition would direct the attention of all concerned to the importance of utilizing the Indian Patent System, which has been in existence for more than 90 years, to the best advantage of this country.

INDIAN PHYTOPATHOLOGICAL SOCIETY

The Mycologists and Plant Pathologists who met at the Indian Agricultural Research Institute, New Delhi, at 5 p.m. on 28th February 1947, resolved to establish a Society to be known as the Indian Phytopathological Society, membership of which is open to all persons and concerns interested in the study of fungi, bacteria, viruses and their useful (industrial fermentations, food yeast, penicillin) and harmful (plant and animal diseases) aspects. The Constitution and Byelaws that had been drawn up, were approved. Those interested can join as Patrons paying Rs. 1,000 (=\$350 or £ 75), or as Life Members paying Rs. 120 (= \$42 or £ 9), or as Ordinary Members paying Rs. 10 (= \$3·50 or 15 shillings) per annum. Both the Life Members and Ordinary Members are required to pay an admission fee of Rs. 10, Patrons and Foreign Members being exempt. A Committee consisting of Mr. J. F. Dastur, Chairman, Drs. B. N. Uppal, S. R. Bose, A. Sattar, with Dr. B. B. Mundkur as Convener to found a Journal, was formed and Dr. B. B. Mundkur was elected Secretary-Treasurer for the year 1947. It was also resolved to designate the members joining before January 10, 1948, as Charter Members. A cordial invitation is extended to all persons and concerns in India and abroad to join the Society and make it a success.

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CURRENT SCIENCE

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OVERSEAS TRAINING OF SCIENTIFIC PERSONNEL

THE appointment of a Committee by the Government of India to review the working of the Scheme for Overseas Training of Scientific Personnel will be warmly and widely welcomed. The step is indicative of the appreciation of certain inherent defects in the scheme as well as of the awareness that it is capable of further improvement. We are not acquainted with details of the terms of reference to the Committee, but we hope that they are comprehensive enough to cover all aspects of the scheme including those pertaining to a proper utilisation and harnessing of scientific and technological man-power, now being trained in England and America.

We have had occasion to write before about the recruitment of students for training overseas, and the difficulties of admission and living accommodation in U.S.A. and U.K. We had suggested that admission might also be sought in universities of other countries, like Australia, New Zealand, Sweden and Russia. Most of the recommendations have been accepted, and efforts are being made to improve the living conditions of students deputed to U.K. Maulana Azad, Member for Education, has made it clear that the Government of India are selecting students for training on the basis of merit and qualification alone. There can hardly be any dispute, both from the short and long-range view, on the soundness of such a procedure.

It is now two years since the scheme was inaugurated. The first batch of "Dalal Boys" are due to arrive within a few months. Arrangements are to be made to receive them and place them in congenial positions. We are painfully aware of lost opportunities and languishing talents in the past. This, we hope, will not happen again. Our men and women must have the full opportunity, the freedom, the stimulating and the contented atmosphere in which they can work and contribute their best to the common cause.

In preparing for the reception of our young men it might be of help to remember the atmosphere, background and method of training in foreign countries. Guided by eminent scientists with sympathy and understanding in laboratories equipped with the latest types of labour-saving devices and precision instruments, they would be returning home on the eve of the long-cherished liberation of our country from bondage. Life in a free country, however short, is sure to have fired them with patriotic fervour and enthusiasm to do their little bit for the regeneration of their motherland even as their counterparts are doing elsewhere.

These people, it must be admitted, will find on their return the same ill-equipped laboratories and a general lack of co-ordination of activities and co-operation in research which they had left behind them when they went abroad. Even the meagre equipment in our laboratories have not been, owing to severe restrictions on imports, replaced and much less added to, for the last seven years, when the pace of scientific advancement in other countries, has been particularly rapid. Our backwardness in establishing, during the war, a scientific instrument industry is equally responsible for the slow advancement of science in India. All the same there is no reason why the enthusiasm of the newcomers should not be carefully nurtured and directed into fruitful channels, or all possible facilities and freedom should not be given to them to carry out work after their own heart. With all our limitations, the elder scientists are in a position to extend to them the very necessary encouragement and co-operation in their efforts to establish a sound, creative atmosphere of science. The incoming young men, on their part, cannot naturally expect to revolutionise Indian scientific research overnight. They have to build up bravely and patiently, at times against odds, the scientific edifice of their dreams. We are confident that both the young and the old will work hand in hand in the cause of science and national progress.

As a measure of replacement of the present scheme of training students abroad, with obvious saving in money and time, the suggestion of Mrs. Ellen Watmull cannot be too strongly recommended. "At the present time it costs from Rs. 30-50 thousand to educate one young person in the United States", writes Mrs. Watmull, "and slightly less in England. Multiply this by 600, the number of Indian students in U.S.A., and you have an impressive sum, Rs. 180-300 lakhs spent every two to three years in U.S.A. alone. Why not send half the number of students, or even less than that, abroad" she rightly asks, "and spend the rest of the money in developing Indian Universities?" Continuing, she writes, "An electron microscope costs about Rs. 25,000, less than the cost of higher education abroad of one Indian student for two years. And what a blessing it will be to have such a microscope in every medical school and technological institute! Similarly laboratory facilities will enable India's scientists to do research second to none in the world."

In such a scheme of expansion and equipment of universities and research institutions in the country, which is also contemplated on a small scale by the Government of India, we would urge on the Government the policy of inviting technical experts and eminent men of science from abroad to train up our young men to the level of efficiency which would bring our academic institutions and, in general, our scientific front, on a par with the best in the world. We could, for instance, invite experts in fisheries and marine industries from Japan, chemical technologists from Germany, mining and metallurgical engineers from Italy, Russia, Canada and America. A measure of the benefit we could gain from such a scheme can be guaged if we remember the enviable place the United States have attained in Science and Technology owing largely to the policy of welcoming refugee intellectuals from foreign lands. It is also worthy of note that Russia is studiously importing German experts to mann her laboratories and industries. The United Kingdom, which has in many respects remained highly conservative, has not hesitated to take this salutary step. We should indeed be losing a great opportunity if we do not follow the example even as our immediate neighbour, Australia, is now doing, without running the risk of condemning our country to remain for a considerable time in the backyard of modern civilisation.

EDITORIAL NOTES

THE ASIAN CONFERENCE

THE Asian Conference that concluded recently in New Delhi promises to be such an eventful landmark in the history of mankind that current science cannot leave it unnoticed. The savants and prophets and scholars and reformers of the fertile East (except, unfortunately, of Japan) had congregated for this historic meeting. One wonders if this is the great meeting that has been prophesied in the Bible.

Addresses were delivered by eminent leaders who have been in the forefront of the fight for freedom in the various countries stressing the indispensable necessity of the independence of each and the mutual support of one another for the social, economic and political development of all if the East has to gain an equality with the West. Spiritually, however, it is recognised that Asia has to give the lead to the rest of the world whose material advancement has far outstripped its moral progress, with a new outlook, a new ideal of life and a correct sense of human values which subordinates the material needs, however necessary, and material achievements, however spectacular, to the moral independence and spiritual glory of man.

At a time when politicians elsewhere in the world are wrangling over petty matters, backing their arguments with threats of atom bombs and bacterial warfare, the message of the East of "Conquering the world with Truth and Love" comes indeed as a cool breeze in the midst of a desert. The inspiring speeches and the unanimity of ideals of peace that were witnessed at the conference provide the hope that an independent, self-directing East will steer humanity clear of the morass of materialism and the whirl pools of power politics which now threaten to plunge the world into devastating war at any moment.

THE INDIAN SUGAR INDUSTRY

THE weak and unhappy position in which the Indian sugar industry finds itself to-day, after fifteen years of uninterrupted and generous protection, is implicit in the recommendation of the Tariff Board to the Government to continue the protection for a further period of one year up to the end of March 1948. The foundations of the industry in India were laid in 1932 by the imposition of a tariff on imported sugar. Fifteen years is a sufficiently long period for any industry to have established itself on a sound basis, and it does little credit to those to whom the destinies of the industry were entrusted to find now that the industry is still unable to stand on its feet. While the industry will ever be grateful to the pioneering work of Barber and Venkatraman and his associates in the domain of cane improvement and cultivation, it is sad to note that processing aspects of the sugar industry have not received any effective attention.

The short-sighted Indian capitalist who has perhaps derived the greatest benefit from the industry, has shown little appreciation of long-term research as a factor in securing its economic stability. There are very few industrialists who maintain competent chemists in their factory, and when they choose to do so, the chemist is employed only for the crushing season. The sugar recovery in Indian plants hardly exceeds 10 per cent., while the corresponding figure for Java is rarely less than 12 per cent., and at times exceeds 13 per cent. And this in spite of the improved varieties of cane which compare in sugar content very favourably with foreign varieties. Thus the Indian capitalist, with the exception of a notable few, forfeited the trust placed in him.

Another aspect of the Industry which has been neglected by the sugar factory owners is the utilisation of by-products and wastes of the sugar plant, the commercial exploitation of which would have naturally served the industry well. There is little research into this aspect of the problem, and less application of even known processes of exploitation. The Indian Council of Agricultural Research which has been spending annually from four to five lakhs of rupees on researches into problems of the sugar industry has concentrated mostly on the agricultural side of the problem. But the dividend-minded capitalist is ever nervous of venturing on projects whose dividend-paying capacity is not a foregone conclusion. The Section of Fermentation Technology of the Indian Institute of Science, for instance, have developed a strain of yeast which yields high concentration washes from molasses and has proved successful in large-scale trials at Daurala and Hargaon, a development which industrialists in other countries would be eager to adopt. Most of the factories in the country, on the other hand, do not have a distillery attached to their factories; the molasses, therefore, goes into the manure heap, thus denying the country a potential source of invaluable power alcohol. In this respect, except for the Governments of Mysore and U.P., which encouraged the production of power alcohol by compelling its incorporation in a certain proportion in motor fuel, the rest of the administrations in India have shown little appreciation of the value of exploiting this by-product to the Industry. It is to be hoped that the Central and Provincial Governments will not be influenced by competitive interests in encouraging, if not compelling, the production of power alcohol from molasses. If indeed the sugar industry is to be put permanently on its feet the administrations must soon make up their minds to encourage commercial exploitation of all the by-products of the industry that are now going to waste.

With respect to this question the Tariff Board has recommended "that the present Central Government grant to the Indian Central Sugarcane Committee of one anna per cwt. from the excise duty on sugar should be increased to four annas per cwt. and that all

facilities should be given to the sugar factories to establish subsidiary industries." While welcoming this move we have only to suggest that a good portion of the Government grant be earmarked for research into problems of immediate interest like the utilisation of molasses for the maximum production of power alcohol, food yeast (from which the B Vitamins can also be manufactured) and of bagasse for the production of paper and boards. Such researches should be planned and directed by a Committee of Experts appointed by Government, and must not, for obvious reasons, be entrusted to unenlightened sugar interests.

CHEMICAL RESEARCH AND INDUSTRY*

MODERN chemistry is undoubtedly the most important of sciences in relation to industry. It is not unlikely that the research carried out in the National Chemical Laboratory at Poona may from the point of view of immediate results for the benefit of industry prove by far the most important of all the National Laboratories which are being established in various centres in India. The rapid industrial development in Western countries was largely the result of development of chemical technology.

We cannot sufficiently emphasise the importance of scientific research for industrial progress. We have not paid adequate attention to research and in consequence the industrial development in our country is at a relatively low level. Those industries which have been developed are largely dependent upon not only imported machinery but on processes made available by the foreign manufacturer. The only advantages that industry depends upon in India are cheaper labour and the advantage of such raw materials as may be available and of course a large and easy market that we have in India by reason of its population. The establishment of the National Chemical Laboratory in close co-operation with industrialists through the Council of Scientific and Industrial Research will, I hope, help to bring Indian industries scientifically and technologically to a higher level of efficiency.

Appeal to Industrialists for Generous Support to Research

On this occasion it may not be inappropriate if I make a very special appeal to all industrialists that money put in scientific research is in the long run a good investment. I appeal for as much funds as industrialists can give to this and the other national laboratories. We cannot always expect immediate returns on investigations undertaken by scientists. Nature is not an easy customer. We have to accept defeat on ten occasions and persevere in order to win on the eleventh occasion. The discovery made at the end of a long series of experiments may in its reward compensate for all the negative results which preceded it and which the patience of the scientists endured with equanimity. The story of Bhagirat who did penance to bring the Ganga down is a parable to illustrate the patience and perseverance and single-minded concentration on scientific research which produce results for practical application in human progress. I would appeal to industrialists and other commonsense people not to expect immediate money-returns for investment in scientific research. To expect immediate returns is a very short-sighted approach to the goddess of science. She will refuse to respond to such advances. Many fields of enquiry and experiment which appear to be wasteful and irrelevant may at the end prove abundantly useful and productive of discoveries of great value. Some things appear at the earlier stages to be academical and of little practical utility. Nobody imagined sometime ago that atoms could have any practical value, but to-day these investigations have resulted in one of the most deadly of the weapons of war. What was mere theory and dream has become too real, indeed one might wish it were less of a reality.

* Extracts from the address by Sri C. Rajagopalachari, Member for Industries and Supplies, Government of India, who presided on the occasion of the Foundation Laying Cermony of the National Chemical Laboratory, at Poona, on the 6th April 1947.

UNESCO, DIVISION OF NATURAL SCIENCE

IMMEDIATELY action will be taken by the Division of Natural Science of UNESCO during 1947, on (1) Reparations in the form of scientific equipment, (2) Aid to biological standardisation (PCBS will be the responsibility of WHO), (3) Investigation of the role of customs duties as barriers to the circulation of scientific equipment, (4) Standardisation of scientific equipment (in the meantime the ISO and the Unions will be encouraged to concern themselves with this), (5) The language question and an auxiliary international language for science, (6) Formation of an international scientific appointments agency, (7) Formation of international chairs at universities, (8) Institution of prizes, laureateships, etc., (9) Commissioning the preparation of school text-books designed to explain the world-view of science, (10) Provision of scientific apparatus and equipment for regions and countries remote from the main centres of science and technology.

THE NATIONAL CHEMICAL LABORATORY

Its Scope and Functions*

By SIR S. S. BHATNAGAR, O.B.E., D.SC., F.R.S.

(Director of Scientific and Industrial Research)

THE NATIONAL CHEMICAL LABORATORY is the fifth in the chain of a series of National Laboratories which the Council of Scientific and Industrial Research has sponsored. On previous functions I dealt at great length on the nature of the National Laboratories. These Laboratories as I have said before are not intended to supplant but to supplement the work of individual or collective industrial concerns in respect of research. They will undertake work of the kind that does not come ordinarily under the purview of the existing industries or universities. One of the main functions of the National Chemical Laboratory will be to bridge the gulf between scientific research and its application to problems of human welfare. The National Chemical Laboratory will undoubtedly take up long-range problems of fundamental research in chemistry—problems which are usually not tackled in the universities for want of funds or lack of facilities for organised co-operative research. Such problems are not sponsored by ordinary industrial organisations as their solution does not hold out prospects of bringing immediate monetary advantages to the industries concerned inasmuch as they must be preceded by pilot plant investigations. That this country is capable of first class scientific work, is well established by the many important contributions made by the Indians in the theoretical field. The road from a scientific discovery or an invention, to its successful industrial application is generally long and tedious and it is this stage which the Indian scientist seldom reaches. His published work is immediately made use of by countries better equipped to traverse the difficult route of application. The Indian businessman very often has neither the staff nor the equipment nor even the insight to appreciate the discovery of his colleagues and so the utilisation of discoveries made in India takes place in some other countries and even the credit of the newness of an Indian idea is snatched away from the real author. I could quote many illustrations. When I was in America in 1944, some notable Indians in America brought several instances to our notice. Such instances are not uncommon even in Britain. The most important recent example is that of the discovery of penicillin which was due to two British scientists, Fleming and Florey, but as England was unable to develop the large-scale or semi-large-scale production of this material during the war, America had to take it up; and the credit due to the British scientists had to be fought for and revived by the British people. Very often the developmental stages involved, require work of high quality and originality and the expenditure generally is much higher than that involved in the discovery of the fundamental principle. India must realise that this developmental work deserves to be recognised as well as the discovery of a principle. Perhaps the most attractive and useful feature of the National Chemical Laboratory will be that it will be equipped and organised to meet the needs for such developmental work for which hardly any laboratory in India is at present equipped. Such work has been almost completely neglected so far by the universities in India.

I cannot do better than quote a few sentences from a booklet issued by the National Chemical Laboratory Planning Committee in which these aims and objects of the proposed laboratory have been described in great detail. According to this book, "The developmental work in the National Chemical Laboratory may take the form of improving old processes in the light of new scientific knowledge or of discovering new processes. The development of new processes will be carried out to the pilot plant stage in the laboratory. When a successful process has been passed on to industry, the National Chemical Laboratory will remain in touch, and any difficulties or problems that may arise in the large-scale manufacture of the product will be brought back to the laboratory for solution. In addition to the processes developed in the National Chemical Laboratory, other problems of industry which fall within the scope of investigations of the National Chemical Laboratory may be taken up. The men at the National Chemical Laboratory even on their own initiative may undertake to investigate technical processes of Indian industry and make improvements in them.

"In this manner the link between the National Chemical Laboratory and the industry will be living and vital, and so will be its link with universities and other scientific institutes in the country where fundamental scientific research work is being pursued. These institutions may be invited to pass on their discoveries and inventions to the National Chemical Laboratory for developing the means to their successful industrial application.

"Some of the most important scientific discoveries during the last half century, which have been of the greatest benefit to mankind, have nearly always resulted from large organisations both of workers and of materials, and have involved expenditure, which falls outside the capacity of the average scientific laboratory. In the same manner technical processes developed in the western countries which have revolutionised industrial development and modern civilization itself, have required huge expenditure of funds and materials. The utilisation of coal tar, fixation of

* Extract of speech delivered by Sir S. S. Bhatnagar on the occasion of Laying the Foundation Stone of the National Chemical Laboratory, at Poona, on the 6th April 1947.

atmospheric nitrogen, the development of plastics and artificial rubber, of artificial textiles and fabrics, the hydrogenation of coal, and the development of the entire petroleum industry are a few important examples out of a large list. The National Chemical Laboratory hopes to be in a position to undertake such difficult, important and expensive research.

"It must be mentioned here that the major problems of industry, or speaking of the wider aspect, those of human welfare are never such as fall within a narrow grove represented by a particular branch of chemistry. More often than not, for the successful solution of a problem, the co-operation of experts from different fields of science is necessary. The National Chemical Laboratory will, therefore, embrace not only chemistry, but also physics, mineralogy, engineering and biology in so far as they relate to chemical problems and the chemical utilisation of national resources. Without the provision of such a wide scope the laboratory may become sterile. The institutes of industrial research in other countries fully recognise this need. The Mellon Institute, which is peprhaps one of the best industrial research institutes in the world dealing with chemistry, has highly developed sections representing biology. The famous Massachusetts Institute of Technology has a department of Biological Engineering which comprises of such subjects as biophysics, food technology, sanitation, nutrition and industrial biology. The National Chemical Laboratory recognising the same principle will have sections of Chemical Engineering and Biological Chemistry and Evaluation.

"It may also be stated that in modern applied research concerted teamwork is becoming more and more essential. The day of the individual research worker is nearly passing away. The solution of problems which arise to-day require the specialized knowledge of a number of experts. It is, therefore, essential that the National Chemical Laboratory while embracing a large number of subjects and experts in different fields should be able to work as a team.

"Last of all, the functions of the National Chemical Laboratory will include the training of research workers in specialised fields of chemistry and technology with particular reference to those for which no provision has been made in the existing scientific laboratories of the country."

The subject of chemistry occupies a unique position in the field of industrial development. There is hardly any finalised industrial product, raw material or process in which chemistry does not play a part. It is obvious that no single laboratory could hope to accomplish everything needed for industrial research in this field and specific problems will have to be solved and fundamental work carried out in numerous other laboratories in the provinces and the universities and in the laboratories of private industries. At the present stage of our country's development, we do, however, need an outstanding laboratory in India which will offer facilities for research work in the more important fields of chemistry. It has therefore, been proposed by the Planning Committee that the National Chemical Laboratory will have the following seven main divisions:—

1. Inorganic and Applied Chemistry.
2. Physical Chemistry including Electro-chemistry.
3. Organic Chemistry.
4. Chemistry of High Polymers.
5. Biochemistry and Biological Evaluation.
6. Chemical Engineering.
7. Survey and Intelligence.

It must not be forgotten that chemistry is an expanding subject and some of the divisions may have to become independent laboratories. For example, Electro-chemistry is fast becoming an important branch of chemistry capable of independent existence and the Council is already exploring the possibility of developing it in a separate laboratory of its own.

It will be noticed that the divisions of Inorganic, Organic or Physical Chemistry and Chemical Engineering cover a wide variety of chemical industries. For example, the division of Inorganic Chemistry and Physical Chemistry jointly will deal with the chemistry and industry of radio-active substances, industrial gases and mineral resources of India and many other industries such as glass, ceramics and clay. Physical Chemistry finds many applications in industry. Industrial catalysis, high and low pressure technique, colloidal solutions, pastes, paints, emulsions and foams, phase-rule separation, electro-metallurgy, electro-chemistry and corrosion constitute some of the types of systems and problems wherein physical chemistry has played an important part in the past and will continue to play an even more significant role. The fascinating research work in Organic Chemistry has contributed greatly to the present chemical age. Civilisation would have been very different and prosaic but for such chemical industries as coal and coal tar products, organic solvents, dyestuffs and intermediate chemicals, drugs, vitamins and hormones, alkaloids and other active principles of plants, essential oils, perfumes and cosmetics, oils, fats, waxes, tannin materials, carbohydrates, detergents, wetting agents and petroleum industries, etc., etc. In fact there is hardly any industry in which Physical and Organic Chemistry have not found direct access and even warm welcome. The section of chemical engineering will enable workers to carry out pilot plant work and help in engineers and chemists being trained to take up the designing and working of large-scale chemical plants. The division of High Polymers will deal with the fascinating field of plastics, paints, rubber and synthetic rubbers. The division of Biochemistry will be helpful in dealing with problems pertaining to life processes and will assist in establishing pharmaceutical industries and health organisations in the country. This is a very live branch of chemistry and India is fast developing an active school of workers in this field. The division of Survey and Intelligence will form an important part and it will deal with survey of raw materials and also provide research, technical information, and library and translation services. It will also carry out the duties

of scientific *liaison* and will provide museum, publication and publicity facilities.

There are hardly any new lands which India can hope to exploit. Science may discover new sources of wealth in the lands we hold and grow new raw materials in them. The only new lands on which we may have our eyes must lie in the domain of the mind and have to be created in the research laboratory. It is on these sources which will emerge from the national laboratories that we have to depend now and in the future for the means to maintain and raise our standard of living and to keep abreast amongst the best nations of the world.

SIR K. S. KRISHNAN

THE announcement recently made by the Hon'ble C. Rajagopalachariar, Member for Industries and Supplies, that Sir K. S. Krishnan, D.SC., F.R.S., has accepted the Directorship of the National Physical Laboratory will be warmly welcomed by readers of *Current Science*.

Professor Krishnan has had a remarkably brilliant career. After completing his University education, Krishnan joined the staff of the Madras Christian College. But his thirst for higher studies and research did not keep him long there. In 1923 he joined the band of research students working under the inspiring guidance of Professor Raman at Calcutta. Placed in the proper environment, Krishnan soon shone as an enthusiastic and brilliant investigator and was foremost among Professor Raman's collaborators. In 1928, he was appointed as Reader in Physics at the Dacca University. This post he occupied only for five years, for, when Prof. Raman left Calcutta in 1933, he unhesitatingly chose Dr. Krishnan to occupy the newly created Mahendralal Sircar Professorship of Physics at the Indian Association for the Cultivation of Science. With characteristic ability, Prof. Krishnan successfully kept up the great traditions acquired during the leadership of Prof. Raman by the Indian Association for Research in Physics. In 1942, the Allahabad University invited him to occupy the Chair of Physics which he accepted. He now relinquishes this post to take up his new appointment.

The research activities of Prof. Krishnan and his associates extend over diverse branches of physics. During the years 1923-1928 he carried out a series of important investigations both theoretical and experimental on the scattering of light, molecular optics and Raman effect in collaboration with Prof. Raman. While at Dacca and later at the Indian Association, Prof. Krishnan initiated and conducted with conspicuous success numerous investigations on the magnetic properties of crystals the results of which were published in the *Transactions of the Royal Society* as Memoirs. Outstanding investigations on the optical properties of crystals and X-ray crystallography have also been carried out by Krishnan and his collaborators. In recognition of his distinguished researches in optics and especially for his study of the influence of magnetism on crystals, the Royal Society of London elected Prof. Krishnan to its Fellowship in 1940. He thus became the sixth Indian and first pupil of Sir Raman to achieve this unique distinction. At Allahabad Prof. Krishnan has built up an active school of research carrying out investigations on the thermal and electrical properties of metals and alloys.

No sketch of Prof. Krishnan's career would be complete without a reference to his extensive travels abroad, which gave him many an opportunity to visit important centres of research in Europe and America and to cultivate personal relations with eminent men of Science. He first visited Europe when he was invited to take part in the International Conference on Photoluminescence held at Warsaw in 1936. He widely toured throughout Europe and delivered a series of lectures at various important centres including the Royal Institution in London and the Cavendish Laboratory at Cambridge and in many of the Continental Universities. The Liege University honoured him with the award of the University Medal. He again visited Europe in 1939 to attend the International Conference on Magnetism held at Strasbourg under the auspices of the International Institute for Intellectual Co-operation and of the Service Central de Recherche Scientifique de France. In the summer of 1946 he went to England as one of the Indian delegates to the Empire Scientific Conference organised by the Royal Society. He also took part in the third annual conference on the X-ray analysis group of the Institute of Physics held in July 1946. At the request of the Government of India he visited Europe and America to survey the modern trends of research in the prominent physical laboratories.

Besides being a Fellow of the Royal Society, Prof. Krishnan is a member of many Scientific Societies in India and abroad. He was the President of the Physics Section at the Madras Session of the Indian Science Congress. He has served in a number of Committees sponsored by the Government of India for the scientific and technical development of the country. In recognition of his services to the cause of Indian science he was knighted in 1946.

It is a matter of national pride that Prof. Krishnan who has had his entire research training in India should have been chosen to be the first Director of the National Physical Laboratory. Simple and unostentatious as he is, Prof. Krishnan is a gifted lecturer, noted for the profundity of his ideas and clarity of expression. With a man of his eminence and experience at the helm, the National Physical Laboratory can be expected with confidence to fulfil the tasks that it is intended to do.

R. S. KRISHNAN.

IDEALS OF SCIENCE*

SCIENCE to-day has come in for a strong indictment at the hands of politicians and the common man, and this is how it is worded in a book which I came across recently :—

"Humanity stands to-day in a position of unique peril. An unanswered question is written across the future: Is man to be the master of the civilization he has created, or is he to be its victim? Can he control the forces which he has himself let loose? Will this intricate machinery which he has built up and this vast body of knowledge which he has appropriated be the servant of the race, or will it be a Frankenstein monster that will slay its own maker? In brief, has man the capacity to keep up with his own machines?"

"... And the necessity of a right answer is perhaps more immediate than we realise. For science is not standing still ..... It is advancing by leaps and bounds, gaining in impetus with each year. It is giving us more machines, faster machines, machines increasingly more intricate and complex."

As I read this passage I began to wonder whether the National Chemical Laboratory of which I was invited to lay the Foundation Stone was going to be a blessing or a curse to India. But soon my doubts were dispersed and I was cheered by a new hope and a new outlook. I know that man is simultaneously a material object, a living being and a focus of mental activities. He appertains to the surface of the earth exactly as trees, plants and animals do. But he also belongs to another world—a world which although enclosed within himself stretches beyond space and time. And in this lie our hope and our salvation.

SCIENCE AND WAR—A FALLACY

The popular indictment of science seemed to me, like many things popular, without any foundation. Can we justly blame science and its discoveries for all the destructive weapons used in the war or must we look elsewhere for the cause? Did we not have wars before even the beginnings of science and did not each war then make use of such knowledge as was then available for the creation of destructive weapons? For all along the ages war has been considered to be an easy way of solving disputes. It is not true then to say that science is responsible for war and for the creation of destructive agencies. If anything, human history seems to indicate that the ideas of war have been carried in their minds by men at all times and in all ages. Science alone is certainly not responsible for war.

Another popular complaint against science is that by the creation of machines she has taken away the joy of manual labour from the lives of men and made labour dull and mechanical. But as against this we must put into the other scale, the rich harvest of benefits which science has offered to humanity. The shortening of long distances and the easy means of communication, to mention only two of them. And every scientific discovery provides a number of constructive uses just as well as it provides the destructive uses. For instance steel is used for destructive weapons; but as against these it is used for a hundred arts of peace. With the atom bomb you also have infinite atomic energy at your command for beneficent use if you so will.

There is one other sin that is popularly ascribed to science, namely, the sin of glorifying the material at the expense of spiritual values. But I do not know that even this charge can stand the test of dispassionate analysis. If by this is meant that science has increased the means of multiplying food and clothes and all the other comforts of life and given us ideas and hope of a better living than was known to the world in the past, the charge is true. But science has also given us a scientific outlook, and the scientific method has taken hold of the minds of all thinking people in the world and it may be that if intelligently and honestly practised, science may be our salvation as much as religion and spiritual practices. Indeed we must not believe that there is a necessary antagonism between these two.

To take a few instances: Take the question of war which looms so prominently before every one of us to-day. In the ages gone by war was the easiest method of solving a dispute between nations. But with the advance of science and the scientific method the minds of all thoughtful people are now turning towards the creation of agencies more for peace than for war, namely, those of international arbitration and international control of problems common to the whole of humanity. It is true that science has increased and brought into existence deadly weapons of destruction, but it has also evolved men's minds to a stage at which the thought of war is replaced by thoughts of peaceful solutions of disputes.

Again take another instance. Science is one of the factors which have shifted the emphasis of our thinking from the salvation of the individual to the salvation of the whole race. The altruistic teaching of every religion worth the name is well known. The good of the people is the ideal of every religion. It is not an exaggeration, in my view, to say that science has actually promoted and made possible the achievement of those ideals. For as science advances and society becomes more and more complex, the individual has to learn more and more to subordinate his own good, to the good of all. And at no time were ideas of social welfare and social responsibility more thought of than in the present scientific age.

It would thus seem that many of the evils which are held at the door of science and scientific advance are a result of popular fallacies and lack of sound thinking. The fault is not in science but in ourselves that we are underlings.

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* Address delivered by Sri. B. G. Kher, Prime Minister of Bombay, on the occasion of Laying the Foundation Stone of the National Chemical Laboratory at Poona, on the 6th April 1947.

Science and Philosophy

We, Indians, are sometimes ridiculed as people being too much interested in matters concerning the spirit, and less with the material arts of life. The fault is attributed by our critics in a great measure to our ancient Hindu Philosophy. But what is this Hindu Philosophy except a very highly evolved and perfected science of life? Anyone who studies the principles of "Yoga" cannot but be impressed by the deep studies in Psychology which our ancestors had made the subject of their life's work. And did we not have in ancient times in our land a highly developed study of the science of astronomy, of mathematics, of medicine, of chemistry or of engineering? I do not know that our Hindu Philosophy which is so much ridiculed ever stood in the way of the study and progress of these sciences.

To my mind the correct view is not to regard the spiritual and the material sciences as two opposing principles or creeds; but to regard them as the two aspects of a single Reality, as two ways to visualise a single Truth, a single Principle, which underlies the phenomena of the universe. Material science works through the bewildering phenomena of nature and seeks to realise the unity that underlies all the diverse facts of Nature. Spiritual science or religion properly so-called working through the self and the states of consciousness, aims at the realisation of the Supreme self, "to know, that, by which all else is known". Both the saint and the scientist must possess the same qualities in order to reach their ideals. Selfless devotion, a meticulous love of Truth, infinite patience, thoroughness and a depth of mind which does not resent criticism in any form, but only makes for the broadest sympathies. Not without these qualities can either of the two reach his goal. But it is my firm belief that the goal which both science and religion reach by different routes is one and the same.

Science and Education

To-day the world is on the verge of moral bankruptcy. The spirit of selfishness, lawlessness and disintegration has spread far and wide. A sentimental pacifism is not the correct reply to these conditions. Science is on the march and is making great strides and with the advance of science the means of destruction are also advancing. Science does not take heed of moral progress. It continues to give us the bare, naked truth and leaves it to us to put it to use, good or evil, according to our moral make-up.

The only solution, to my mind, appears to be so to reconstruct fashion and extend our educational machinery that the moral progress of men including Scientists, keeps pace with the progress in science. We must use every valuable means at our command, religious, social, educational through individuals, groups and nations for the elevation of our moral standards. The problem of science is the problem of better education of the people. We must create higher ethical values. No one will dispute that the mechanical, physical and chemical sciences are incapable of giving us intelligence, moral discipline, health, nervous equilibrium, security and peace. But they will help us in our great task of creating the "Science of Man" which will be the task of the future. We must study Reality in all its aspects and to-day's function is an attempt to help us to do so in one of them.

The Chemical Laboratory—A Symbol of Our Future Greatness

The National Chemical Laboratory of which I have just had the honour and the good fortune to lay the Foundation Stone, promises to be the symbol of our future greatness as a Nation. The wheels of fortune have turned and we seem to be on the eve of the restoration of our former glory. Here, the scientists of our country will devote themselves to the search after Truths of Nature and thereby help the nation, let us hope, to achieve prosperity, material as well as spiritual. And in this respect its position will be unique. Its most important function will be to bridge the gulf between science and its application; it will be a link between the Institutes for the study and research in pure science on the one hand and the national industries on the other. On the other hand, the National Chemical Laboratory will itself undertake fundamental research in pure science, thus leading to greater and better industrialisation. For is not pure science really the mother of modern Industry? On the other hand, greater industrialisation must inevitably stimulate the advance of science all round.

An Appeal and a Warning

The task of the seeker is always a very long and arduous one. This is no less true of discoveries in science and their application. Apart from these, the difficulties of finance, and the right type of workers must also be taken account of. But it is equally true that only continuous and untiring research can win for us new discoveries and inventions. And while I am on these difficulties, I will take the opportunity to make a special appeal to the industrialists. I would say to them, "Do not fall into the error of supposing, as you are very likely to do, that scientific or industrial progress can be made by entrusting everything to a paternal Government, and putting the whole responsibility for all initiative on it. Do not imagine that because Government have established this laboratory, Government alone must undertake all projects and experiments for the development of science and give you the benefit of these." Rather, be prepared to shoulder a major part of the responsibility, financial or otherwise, with the Government. Do not do away with your own private industrial laboratories, where alone industrial research is best stimulated. Nor must you stint in your support to this Institution and the others such as the Universities. I mention with great pride the example of the House of Tatas, whose contributions to schemes of National welfare have always been munificent. That is an example which you all must emulate if you believe in the progress of this country. If you keep that ideal before yourselves, Indian Industry cannot fail.

SUGARCANE IN INDIA—A RETROSPECT AND PROSPECT*

ADDRESSING the Section of Agricultural Sciences, Mr. N. L. Dutt traced the growth of sugarcane cultivation in India. "Sugarcane and sugar have been known in India from the earliest times, philological and botanical evidences indicate that India is the home of sugarcane (*Saccharum Barberi*)." The tropical canes introduced by the East India Company met with failure. "Capt. Sleeman (1827) brought the Mauritius canes to India; he introduced thick canes which belong to *Saccharum officianarum* L., are still being grown in certain parts of the country but on a limited scale and have now acquired local names." The last decade of the nineteenth century saw a revolution in the method of cane improvement in Java and Barbados by the discovery of fertile seed in sugarcane, but "India had to wait for thirty-one years" before she was able to effect cane improvement by "seminal selection".

Mr. Dutt paid tribute to the work of Mollison in Bombay, Woodhouse and Basu in Bihar (during the early years of the work of the Agricultural Department) and the yeoman and pioneering work done by Dr. Barber and Sir T. S. Venkataraman in establishing the Coimbatore Breeding Station and evolving suitable seedling canes benefiting the Indian sugarcane-growers, and added that during recent years the economic canes of Coimbatore—Co. 313, Co. 331, Co. 290 and Co. 419 were intimately connected with the prosperity of the sugarcane industry in India.

As regards the classification of canes, Mr. Dutt opined that "the actual allocation of the indigenous Indian canes" which were good many in number, to specific groups attempted by Dr. Barber has yet to be completed. But from the investigation attempted so far, Dr. Parthasarathy has suggested the probable origin of Indian canes by extensive hybridization between *S. officianarum* and *S. spontaneum*. The present position of the taxonomy of *Saccharum* according to Mr. Dutt is that *Erianthus* should be separated from *Saccharum* and that *Erianthus arundinaceum* might be considered as probable source for the origin of the cultivated canes. Mr. Dutt emphasized the necessity for setting up a *S. spontaneum* expedition for studying wild types as it has been of the greatest assistance for evolving economic types, and showed that the geographical trend of distribution of *S. spontaneum* in respect of form with increased number of chromosomes was from north-west to south-east in India.

Mr. Dutt urged the need for a large number of Provincial Sugarcane Stations devoted exclusively for sugarcane work where suitable varieties for tracts should be tested before releasing for general cultivation. He showed how the Stations already established—Muzaffarnagar, Gorakhpur, Patna, Bombay and Madras—had done "work of great utility on the varietal, cultural, manurial, cane-growth, sucrose development, embryological and mycological aspect" and "sugarcane soils", but observed the paucity of Cane Development Departments in the Provinces and States. He felt that there was a great necessity for a Cane Development Department in every Province to spread the benefits of research to the ryots scientifically and consistently.

After eulogising the Indian farmer who was not slow in taking up "when once he is convinced of the utility of an innovation," Mr. Dutt concluded that the "work on planned cultivation has only just begun and the Coimbatore canes have begun to contribute to the success of the industry in North India (and now also in Bombay and Madras). The present is, therefore, not an Epilogue but a Prologue for the great chapter on Sugacane Research, which it is hoped, will be written in the wake of the stabilization of the nascent sugar industry in the next decade."

L. S. D.

* Summary of Mr. N. L. Dutt's Presidential Address to the Section of Agriculture, Indian Science Congress, Delhi, 1947.

SCIENTIFIC MAN-POWER COMMITTEE

THE Government of India have appointed a Scientific Man-Power Committee to assess the Nation's requirements for different grades of scientific and technical personnel during the next ten years and to recommend the steps to be taken during the next five years to meet these requirements.

The personnel of the Committee is as follows:— *Chairman*: Sir Shafaat Ahmed Khan; *Members*: Mr. Afzal Hussain, Dr. Homi Bhabha, Sir S. S. Bhatnagar, Dr. K. A. Hamied, Mrs. Hansa Mehta, Prof. Humayun Kabir, Col. K. H. James, Rai Bahadur A. N. Khosla, Sir K. S. Krishnan, Mr. G. L. Mehta, Prof. J. N. Mukherjee, Dr. M. Qureshi, Dr. Birbal Sahni, Wing-Commander H. Singh, Dr. D. N. Wadia, and Dr. S. R. Sen Gupta (Secretary).

The Commitee is to report within six months and is expected to meet early in May.

LETTERS TO THE EDITOR

SOME NEW RESULTS REGARDING SPHERICALLY SYMMETRICAL FIELDS IN RELATIVITY

IN a series of investigations concerning spherically symmetrical gravitational fields in relativity a number of important results have been recently obtained by my student-collaborators and myself. The details are being published elsewhere and only certain selected results are reported here. A line-element of the form,

$$ds^2 = -e^{\mu}(dx^2 + dy^2 + dz^2) + e^{\nu}\,dt^2,$$

where

$$\mu = \mu(r, t), \quad \nu = \nu(r, t), \quad r^2 = x^2 + y^2 + z^2,$$

is taken along with an energy-momentum tensor, with the surviving components,

$$T_1^1 = T_2^2 = T_3^3 = -p, \quad T_4^4 = \rho.$$

It is then found that

$$e^{\mu/2}\left(\frac{\mu''}{2} - \frac{\mu'}{2r} - \frac{\mu'^2}{4}\right) = \beta(r), \tag{1}$$

$$-4\pi\rho' e^{3\mu/2} = \beta' + 3\beta/r, \tag{2}$$

$$\int_a^r 4\pi\rho r^2 e^{\mu}\, d(r e^{\mu/2}) + \int_{t_0}^t p \frac{\partial}{\partial t}\left(\frac{4\pi}{3} e^{3\mu/2} r^3\right) dt$$
$$= \left[\tfrac{1}{3}\beta r^3\right]_a^r - \left[\frac{4\pi}{3} r^3 \rho e^{3\mu/2}\right]_{r=a} + \left[\frac{4\pi}{3}\rho e^{3\mu/2} r^3\right]_{t=t_0}, \tag{3}$$

where a dash denotes a differentiation with regard to r, β is an arbitrary function of r only and a, t_0 are arbitrary but fixed limits of integration. Tolman's[1] energy-expression U is found to assume the simple form,

$$U(r, t) = \left[-\tfrac{1}{2}\mu' e^{(\mu+\nu)/2} r^2\right]^r_0. \tag{4}$$

The results (1), (2), (3) and (4) are all new. Professor P. C. Vaidya (of M. T. B. College, Surat) has independently obtained (4) and solved by means of it the problem of a homogeneous spherical distribution surrounded by a different homogeneous spherical distribution. The integral (1) has escaped the attention of previous investigators. It leads to (3) which is a very convenient expression for the energy-content in terms of the boundary values. The result recently reported in *Nature*[2] by Karmarkar and myself is based on (3).

Karmarkar has been able to show that if the line-element is taken in the form,

$$ds^2 = -e^{\lambda} dr^2 - r^2(d\theta^2 + \sin^2\theta\, d\phi) + e^{\nu} dt^2,$$
$$\lambda = \lambda(r, t), \quad \nu = \nu(r, t),$$

it is generally of class two but it becomes of class one in case

$$e^{\nu}\left(\tfrac{1}{2}\nu'' + \tfrac{1}{4}\nu'^2 - \tfrac{1}{4}\lambda'\nu'\right) - e^{\lambda}\left(\frac{\ddot{\lambda}}{2} + \frac{\dot{\lambda}^2}{4} - \frac{\dot{\lambda}\dot{\nu}}{4}\right)$$
$$= \tfrac{1}{4}\left(e^{\nu}\nu'\lambda' - e^{\lambda}\dot{\lambda}^2\right)/(e^{\lambda} - 1). \tag{5}$$

The condition implies, in the absence of motion

$$\text{(i) } \rho' = 0, \text{ or (ii) } \rho = 3p + p'r, \tag{6}$$

when the cosmological constant is ignored. The result (5) was independently obtained by K. P. Singh also.

Benares Hindu University, V. V. NARLIKAR.
March 25, 1947.

1. Tolman, R. C., *Relativity, Thermodynamics and Cosmology*, 1934, 234. 2. Narlikar, V. V., and Karmarkar, K. R., *Nature*, 1946, **158**, 550.

ARE OPTICAL IMAGES AXIALLY INVERSABLE?

KILPATRICK noticed that, when a rough surface like a plastered wall with projecting sand grains was illuminated obliqely and examined through a telescope, the projections on the wall appear to the eye as depressions. As an explanation for this puzzle,[2] he suggests that there may be an axial inversion of optical images, in addition to the vertical and lateral ones. Hudson[3] describes cases of microscopical examination of metallic surfaces in which indentations appear in the optical images as protuberances. He reproduces a macrophotograph of a plate of metallic silver taken with vertical illumination, in which corrosion pits appear as definite excrescences. He also cites a similar instance where the incised engraving on a presentation gold watch, on examination through a low-power microscope, appeared to him in distinct relief. These observations seem to support the argument of Kirkpatrick. Hudson is nevertheless led to question the objectivity of the suggested inversion on examining a photograph of three hollow stone querns, which also he reproduces in his paper. These querns appear to the eye in the photograph as rounded convex stones and "invert" into the concave mortars they really are on merely turning the photograph upside down.

Walls[4] says that the last observation of Hudson is based on the fact that natural illumination of objects is from above downwards; and identifies it as "cameo-intaglio illusion". He proceeds to state that whether top-lighted convexities in an inverted image or photograph will be seen as concavities or not depends on the observer's familiarity with the real object, the inversibility being easy if the object is totally unfamiliar. He, therefore, asserts that this so-called axial or longitudinal inversion is purely subjective. Walls has not, however, offered any explanation for the anomalous appearance of the telescopical and microscopical images of the surfaces observed by Kirkpatrick and Hudson, on which observations the case for a possible axial inversion of optical images actually stands.

I have been carrying out some work on the visual perception of the depth and dimensions of objects in connection with certain investigations in meteorological optics. I have put forward the view, in suggesting an explanation for the variation of the apparent shape of the sky with intensity of illumination,[5] that, under identical conditions of observation, the darker of two similar objects tends to impress the eye as being more distant and bigger than the brighter.[6] The apparent enlargement of the sun and the moon near the horizon[7] as well as the anomalous variation of the visual shape of the overcast sky[8] stand readily explained on the basis of this view, as I have shown in my earlier publications in this *Journal*. Objects or parts of objects, which are more distant from an observer, diffuse less light towards the eye than relatively nearer ones, under the natural conditions of illumination. The eye is, therefore, trained by endless experience to associate larger distances with greater shade and smaller distances with greater brightness.

The manner of illumination of the irregularities of a telescopically- or microscopically-examined object will thus largely determine their apparent depth. Pits or dents on a plane surface should normally be seen in diffuse radiation as dark patches on a bright background, the greater the depth of the dent, the darker being its shade. With excrescences on the observed surface, the eye would conversely associate greater brightness relative to the background. If, by suitable arrangements for illumination, the dents are made to look brighter than the background they will look axially "inverted" into protuberances and *vice versa*, irrespective of whether they are seen with the naked eye or through a lens. In the examples cited by Hudson and Kirkpatrick, this is how the apparent inversion may have arisen. Metallic surfaces are viewed in reflected light from sources of illumination placed above them; the dents in those surfaces would, therefore, catch and imprison a few rays of light and multiply reflect them internally, with the result that they give rise to bright spots at their centres. Hudson himself states that, in all metallographic work, a depression in a microscopical image of a metallic surface may be safely assumed to have a white spot at the centre and may indeed be thus identified.

It may, therefore, be stated that the so-called "axial inversion" of optical images is a subjective illusion and arises out of the greater depth the eye is trained by experience to associate with darker objects. We always believe we see such objects as would, under conditions of normal vision, produce the retinal image of which we are actually conscious.

If "axial inversion" of optical images through lenses were indeed to be objective, not only would all rules of focussing be rendered topsy-turvy, as Walls points out, but no object will bear any physical semblance to its optical image. Thus, a human face should look through a lens, apart from the vertical inversion, like the inside of its mould—a hypothetical aberration, which, if genuine, would manifest itself only if there is an odd number of lenses in an optical system. Nor can it be argued that this inversion is only selectively true for objects of sizes smaller than a certain optimum limit and that it fails in other cases;

for inversability, if objective, cannot, by any means, be limited in its demonstrability.

Meteorological Office,
St. Thomas' Mount,
Madras, D. VENKATESWARA RAO.
March 26, 1947.

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THE UTILITY OF "DESERT COOLERS"

IN recent years, what are called "Desert Coolers" have come into vogue in Northern India, to mitigate the rigours of the hot weather. In 1945, a few rooms in the Meteorological Office at Lodi Road, New Delhi, were provided with such "super coolers", manufactured by Refrigerators (India), Ltd. They work on the same physical principle as the well-known and commonly used "khus" tatties, *viz.*, the evaporative cooling of hot dry air.

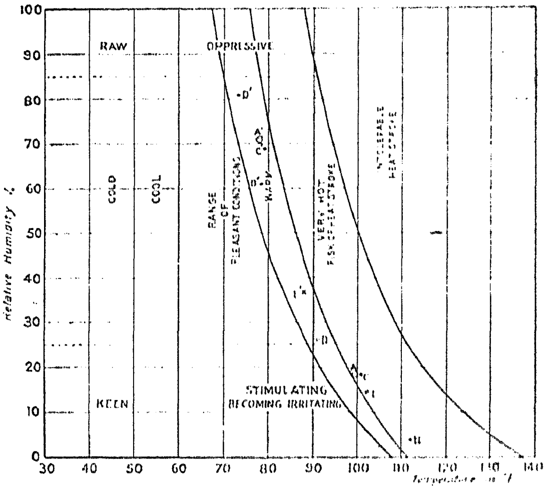
The model used contained a motor of about ¼ or ⅓ H.P. driving a centrifugal fan which forced about 2,500 c. ft. of air per minute into the room which was about 6,000 c. ft. capacity. The outside air passes through the three louvred sides of the box enclosing the driving fan, the sides consisting of wood-wool pads kept wet by water pumped up by the same motor and fed from a small tank which forms part of the equipment. It goes out into the room to be cooled, through the fourth open side. The room used to be kept closed, except for the inlet for the cold air and small openings for circulation outlets. The "cooler" was fixed just outside a window and another ventilator or window or a door was left ajar for ventilation. Within a comparatively short time, say half an hour, the interior of a hot-room became quite comfortable, and remained so as long as the "cooler" was working.

In order to get a numerical idea of the cooling effects, the present writer had a series of readings taken for about 30 to 40 days in May, June and the first fortnight of July in 1945, at 12, 15 and 17 hrs. Readings of dry bulb and wet bulb temperatures were taken with an Assmann Psychrometer (1) in the open in shade, outside the room which was cooled, (2) inside the room just in front of the "cooler" and (3) in the farthest portion of the room. On a few typical days similar readings were also taken without the "cooler" working. A few readings in other portions of the building, non-cooled rooms and corridors were also taken for comparison. The open air temperatures during the whole series ranged mostly from 90° F. to 112° F. Inside, in front of the "cooler" they were round about 65°–80° F. and farthest in the room from about 70° F. to 90° F. As is naturally to be expected, the wet bulb temperature is not sensibly altered. Mean values based on 104 different observations are those given under (A) in the table below which also contains three typical individual observations for comparison, (B), (C), (D). Readings without the "cooler" being worked, on a few typical days, (E) in the Table, indicate that while the temperatures in the open air were of the order of D.B. 102°, W.B. 70° and R.H. 15 per cent., inside the room they were about 90° with a humidity of about 35 per cent. In other rooms (non-closed) and corridors, the D.B. temperatures were about 5 degrees higher. These figures corroborate the common experience that merely keeping rooms closed during the hot part of the day keeps down the temperatures substantially, but the air becomes moister, whereas with the "cooler" the air cools down still further to a more comfortable level although the humidity also increases considerably.

It is interesting to see what exactly these conditions mean as regards human comfort. The "cooler" filled the room with air of which the D.B. was substantially reduced, but the W.B. remained the same, which meant a considerable increase in the humidity. By contrast this air feels much more comfortable though intrinsically it is not particularly "pleasant". It is interesting to see what this represents according to the "tentative classification of climates", by D. Brunt (vide *Nature*,

	Open air			In the cooled room					
				In front of cooler			Farthest from cooler		
	D. B.	W. B.	R. H. %	D. B.	W. B.	R. H. %	D. B.	W. B.	R. H. %
(A) Mean of 104 readings	99·8	70·4	18	77·9	71·4	71	83·5	73·4	69
(B) 15h– 13·6·45	111·6	68·0	4	77·9	68·9	61	85·1	73·0	54
(C) 12h– 14·6·45	100·8	71·1	18	78·8	71·6	69	86·5	73·6	52
(D) 12h– 30·5·45	90·9	68·0	26	72·9	68·7	81	82·4	72·3	60
(E) Without cooler working (mean of 9 readings)	102·2	70·0	15	87·7	69·9	37	89·2	70·3	35

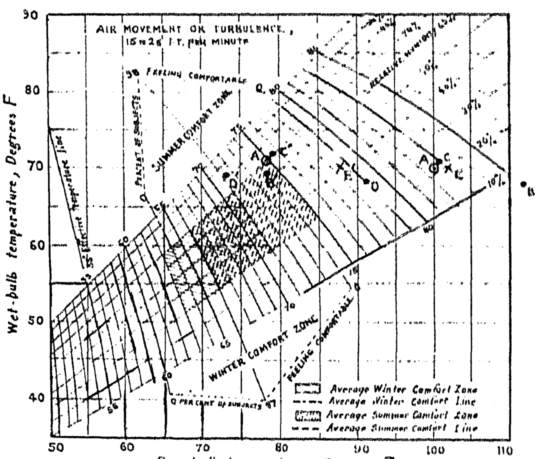
Vol. 155, No. 3941, p. 563, 12th May 1945). In Fig. 1, which is Brunt's diagram, points A, B,



A TENTATIVE CLASSIFICATION OF CLIMATES.
By D. Brunt

FIG. 1

C, D and E represent open air conditions given in the Table; whereas A′, B′, C″, D′, and E′ are the corresponding conditions in front of the "cooler". What the "cooler" has done is that it has brought conditions which were "very hot, risk of heat stroke" to the "warm" zone in all cases except D which remained in the original 'warm' zone but with added humidity. Simply keeping rooms closed also serves similar purpose (see points E and E′); but at a lower comfort level as experience shows. Similarly Fig. 2 shows the "Comfort



COMFORT CHART
OF AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS.

FIG. 2

Chart of the American Society of Heating and Ventilating Engineers" in which the points corresponding to A to E and A′ to E′ are shown. This also shows that the "cooler" brought the conditions of discomfort just near to the border of "summer comfort zone".

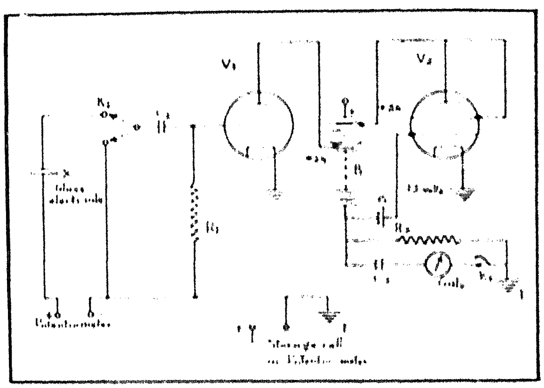
Meteorological Office,
Poona 5,
March 24, 1947. V. V. SOHONI.

A 2-STAGE AMPLIFICATION LABORATORY ASSEMBLY FOR THE GLASS ELECTRODE pH METER

THE ready-made commercial type pH meters were found not always quite satisfactory. Little defects could neither be easily set right nor could desirable improvements made without the help of the makers. After experiencing such difficulties we sought to devise a simple type of pH meter with the materials available in the laboratory or in the market. The following diagram is self-explanatory. It will be noticed that the assembly is a modification of the Morton[1] and Goodhue[2] types.

CHARACTERISTICS

1. We use two valves 1H4 and 1A4 which have low ratings and low consumptions workable with 2 volts accumulator or even dry cells.



R_1 = 5 Megohms		V_1	1H4
R_2 = 20,000 ohms.		V_2	1A4
C_1 = 0·1 μf (Mica)		B	45 Volts dry cell.
C_2 = 4 μf (Paper or oil)		G	9 Volts grid battery

2. Since the plate ratings are low, drainage on the battery is very small, and 45 volts "Eveready" battery can be used without deterioration for a long time.

3. An ordinary ballistic galvanometer is used as a null point detector.

4. The assembly is shielded and protected against external electrostatic potentials.

5. Being a null point detector the zero drift of the galvanometer does not affect the potentiometer readings. The initial kick in the galvanometer (when it is switched on) can be eliminated by a shunting device.

6. The potentiometer is calibrated in the usual way by employing buffer solutions of known pH.

Depts. of Physics & Chemistry,
Lucknow University, S. S. SRIVASTAVA.
March 24, 1947. M. R. NAYAR.

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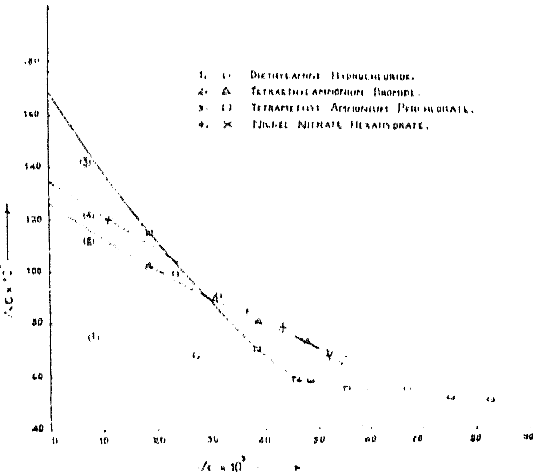
CONDUCTANCE OF SALTS IN DI-ETHANOLAMINE AS A NON-AQUEOUS SOLVENT

THE study of conductance in non-aqueous solvents has been made by a number of workers both for understanding the nature of these solutions and also for testing the various theories of conductance that have been developed in this field. But for systems where the solvent is very viscous and also where solvent molecules are large or of the same order of magnitude as the solute molecules, little work has been done.[1] In this note data for the electrical conductivity of solutions of a number or organic and inorganic electrolytes, *e.g.*, tetraethylammonium bromide, tetramethyl ammonium perchlorate, diethylamine hydrochloride and nickel nitrate in a very viscous solvent, diethanolamine $(C_2H_4OH)_2$ NH, have been recorded. Diethanolamine should behave both as an alcoholic solvent as well as a strong ammoniacal base and has a viscosity, $\eta = 3 \cdot 676$ poise at 30° C.

The Debye-Hückel-Onsager's equation[2] $\lambda_c = \lambda_0 - x\sqrt{c}$ (where λ_0 = equivalent conductivity at infinite dilution, λ_c = equivalent conductivity at concentration c and x = Onsager's slope), has been applied to get an approximate value of λ_0 in every case. For this, λ_c was plotted as ordinate against $\sqrt{c}$ and a freehand curve or a straight line as the case may be was drawn as shown in the figure. From these



graphs λ_0 was obtained by extrapolating to zero-concentration of the electrolyte and the values are recorded in the following table.

Temperature 30° C.

Solvent = Diethanolamine ($\eta = 3 \cdot 676$ poise)

Electrolyte	$\lambda_0 \cdot 10^2$
$(C_2H_5)_4N\,Br$	126·0
$(CH_3)_4N\,ClO_4$	168·0
$(C_2H_5)_2NH.HCl$	84·5
$Ni(NO_3)_2 \cdot 6H_2O$	134·5

Our best thanks are due to Sir J. C. Ghosh, Kt., D.Sc., F.N.I., for the interest he has taken during the course of this investigation.

Further work is in progress.

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A. K. BHADRA.
Dept. of Pure & Applied Chemistry,
Indian Institute of Science,
Bangalore,
April 15, 1947.

1. Elliot and Fuoss, *J. Amer. Chem. Soc.*, 1939, **61**, 294; Friscoe and Dirkse, *J. Phys. Chem.*, 19420, **44**, 388. 2. Debye and Hückel, *Physik. Z.*, 1923, **4**, 185, 205; Onsager, *Ibid.*, 1926, **27**, 388; 1927, **28**, 277.

ON THE SUITABILITY OF THE DI ELECTRIC CONSTANT METHOD FOR THE DETERMINATION OF MOISTURE IN LAC

THE moisture content of lac usually varies from about 1 to 3 per cent. depending mostly on the humidity of the atmosphere. Although the range of variation may appear to be small, its determination is often necessary since it influences some of the important physical properties, such as fluidity,[1] solubility,[2] polymerisability, etc. The usual method of drying a substance to constant weight at 100° C. or above is not applicable to lac since it easily gives off its combined water at such high temperatures resulting in a partially polymerised product. Other methods[3] involve the employment of vacuum desiccation at lower temperatures. But as all these methods are cumbersome and time-consuming, the need for a rapid, reproducible and accurate method for the determination of moisture in lac, has always been felt.

The results of experiments with a specially designed cylindrical condenser showed, however, that there is practically no increase in capacitance till the moisture content rises from zero to about 1·4 per cent. (moisture determinations being made by the I.L.R.I. method[1]). A further increase in the quantity of moisture in lac results in a slow but gradual rise in the value of capacitance of the experimental condenser till almost the saturation point of moisture is reached, when, however, a rapid increase in capacitance can be observed. The following table embodying the results of measurement on a sample of powdered kusum lac illustrates this.

Moisture content of lac (percentages after conditioning at different humidities)	Capacitance of the condenser in micro micro-farad at the frequency of	
	100 kc/s.	1 kc/s.
0·00	56·0	72·0
0·75	56·0	72·5
0·88	56·0	72·0
1·26	56·5	72·0
1·43	56·0	72·5
1·52	56·5	73·0
1·70	57·0	74·0
2·25	60·5	76·0
2·62	66·0	82·5

This anomalous increase in capacitance due to gradual absorption of moisture is to be expected from our previous finding on the role and nature of moisture based on the study of the dielectric properties of different mixtures of hard and soft lac.[5] The moisture that is first taken up by dry lac enters into some sort of combination with it being adsorbed on the surface in such a way that the water molecules become more or less fixed and, therefore, incapable of orientation in the alternating electric fields. As the moisture content gradually increases, layers of water molecules following upon those strongly adsorbed on the surface have more and more freedom for orientation and as a consequence an increase in dielectric constant or capacitance is noticed. The results obtained for lac by the dielectric constant method, therefore, cannot be correlated with those obtained by the existing methods of moisture determination, since the increase in capacitance, which is too small to be observed at the initial stages, is also not proportional to the moisture content when it increases to a measurable magnitude later.

Physical Laboratory,
Indian Lac Research Institute,
Namkum P.O., G. N. BHATTACHARYA.
Ranchi,
January 15, 1947.

1 Townend and Clayton. *J. Ind. Eng. Chem.. Anal. Edn.*, 1936, **2**, 108. 2. Palit, *J. Ind. Chem. Soc.*, 1940 **17**, 308 3. Rangaswami and Sen, *A Handbook of Shellac Analysis*, 1942, **7**. 4. —, *Ibid.* 1942, **8**. 5. Bhattacharya, *Ind. J. Phys.*, 1944, **18**, 116.

PHOTOCHEMICAL AFTER-EFFECT IN THE DECOMPOSITION OF HYDROGEN PEROXIDE BY POTASSIUM FERROCYANIDE

It is well known that a pre-illuminated solution of potassium ferrocyanide decomposes hydrogen peroxide in the dark at a much higher rate than a solution which has not been exposed to light.[1,2] In the course of a systematic investigation of this marked photochemical after-effect it was found that a dilute, freshly prepared aqueous solution of pure potassium ferrocyanide decomposes hydrogen peroxide at a fairly constant unimolecular rate in the dark, but the same reaction employing aqueous ferrocyanide which has been kept in the dark for a few days, or heated to 80-90° C. before use, shows an appreciable and distinct fall in the rate of decomposition in the initial stage of the reaction. A solution of potassium ferrocyanide which is used a few minutes after an hour's insolation shows a similar behaviour. When, however, pre-illuminated solution of ferrocyanide is added to hydrogen peroxide in the dark immediately after darkening, the decomposition of the latter continues with a uniformly high velocity to the end. Further it has been established that one minute's insolation of ferrocyanide produces the maximum reaction acceleration.

In the following experiments, which were performed at 40 ± 1° C., M/64 potassium ferrocyanide (10 c.c.) was insolated for various time intervals and mixed with hydrogen peroxide in the dark as soon as practicable after darkening. The strengths of ferrocyanide and hydrogen peroxide were M/320 and N/6 respectively. The total volume of the reaction mixture was 50 c.c. In the following table, 'T' indicates the time of pre-illumination by direct sunlight of potassium ferrocyanide before it was added to hydrogen peroxide in the dark:—

T	$K.10^5$
10 sec.	168
30 sec.	250
1 mt.	449
2 mts.	348
5 mts.	274
10 mts.	167
30 mts.	105
60 mts.	87

$K.10^5$ for the reaction in the dark with unilluminated ferrocyanide = 35.

These experiments show that there is a well-marked increase in the photochemical after-effect in the beginning, with a subsequent rise to a maximum, followed by a gradual decrease with increasing periods of pre-illumination of ferrocyanide. Experiments with higher concentrations of the latter give similar results, although the effect of long exposure on concentrated solutions is not as pronounced as on dilute solutions.

In the course of these investigations, it was discovered that the activity of pre-illuminated ferrocyanide vanishes completely within a short time after darkening. It has been remarked earlier that the reactions performed with pre-illuminated solutions of ferrocyanide a short time (five minutes) after darkening give in the initial stage of decomposition a distinctly lower value of the velocity constant than with unilluminated solutions. It has been observed that there is a measurable interval between the cessation of illumination and the complete disappearance of activity in the pre-illuminated solutions of ferrocyanide. Below are given some figures showing the fall in the photochemical after-effect with increasing time intervals (T) between the cessation of illumination of ferrocyanide and its addition to hydrogen peroxide in the dark. The period of pre-illumination was one minute.

T	$K.10^5$
30 sec.	229
1 mt.	119
2 mts.	74
5 mts.	39

The diminution of activity with time is very sharp, but a measurable after-effect of illumination is detectable even in solutions used two minutes after illumination.

In view of the above observations, the author is led to the conclusion that the dark reaction between hydrogen peroxide and a pure aqueous solution of potassium ferrocyanide is really due to the action of the former on potassium aquopentacyanoferrite, which exists as a substitution product in very slight concentration in the aqueous solution of potassium ferrocyanide in the dark.

$$K_4Fe(CN)_6 + H_2O \rightleftharpoons K_3Fe(CN)_5H_2O + KCN \quad (I)$$

Such an equilibrium in the dark has also been postulated by Briggs.[3]

It is now suggested that on illumination of (I) the equilibrium is shifted far to the right, tending to set up a photostationary state, with increased concentration of potassium aquopentacyanoferrite, and consequently marked activity of the insolated solution.

$$K_4Fe(CN)_6 + H_2O \underset{\text{Dark}}{\overset{\text{Light}}{\rightleftharpoons}} K_3Fe(CN)_5H_2O + KCN \quad (II)$$

The aquo complex salt causes the photochemical after-effect. The reversion of (II) in the dark takes a measurable time, and thus explains the results shown in the last table.

Potassium aquopentacyanoferrite reacts with hydrogen peroxide as follows:—

$$2\,K_3Fe(CN)_5H_2O + H_2O_2 \rightarrow 2\,K_2Fe(CN)_5H_2O + 2KOH + \text{Energy} \quad (III)$$

The primary oxidation process (III) is a highly exothermic reaction. This primary impulse may bring about the decomposition of a large number of hydrogen peroxide molecules by some yet unelucidated mechanism. The aquo-salt produced in (III) is reduced as below:—

$$K_2Fe(CN)_5H_2O + K_4Fe(CN)_6 \rightleftharpoons K_3Fe(CN)_5H_2O + K_3Fe(CN)_6 \quad (IV)$$

Thus the stationary concentration of aquoferrite tends to be kept constant in presence of a large excess of ferrocyanide. The catalytic system $Fe(CN)_5H_2O''' \rightleftharpoons Fe(CN)_5H_2O''$ decomposes hydrogen peroxide at a high velocity, thus accounting for the marked photochemical after-effect.

It has been further observed that in aqueous solution, aquopentacyanoferrite undergoes a slow and complicated change on standing in the dark, finally producing ferrocyanide, ferricyanide and ferric hydroxide. Thus:—

$$Fe(CN)_5H_2O''' \rightarrow Fe(CN)_5''' + H_2O$$
$$Fe(CN)_5''' \rightarrow Fe^{+++} + 5\,CN'$$

This reaction is accelerated by heat and also by light, since aquopentacyanoferrite is photosensitive. In view of these changes, the behaviour of aged and heated solutions of ferrocyanide and the insolated solutions which are used sometime after darkening can be explained. Prolonged exposure of (II) results in the photo-decomposition of the aquo-salt, and the consequent lowering in its concentration. The maximum photochemical after-effect obtained with one minute's insolation and its subsequent diminution with prolonged insolation are thus to be expected.

Experimental evidence in support of these considerations has been adduced, and will form the subject of a separate communication.

The details of this investigation will appear elsewhere.

Chemical Laboratory,
Archæological Survey of India,
Dehra Dun, B. B. Lal.
February 1, 1947.

1. Kistiakowsky, W., *Zeit. Physikal. Chem.*, 1900, **35**, 431. 2. Lal, B. B., *Jour. Ind. Chem. Soc.*, 1939, **16**, 7, 321. 3. Briggs, S. H. C., *J.C.S.*, 1920, **117**, 1029.

RESORCINOL-SUCCINEIN AS ADSORPTION INDICATOR IN ARGENTOMETRIC TITRATIONS

Following the discovery of Fajans,[1] an intensive study has been made of phthaleins, sulphophthaleins and a few other dyes as adsorption indicators in precipitation reactions. Trials with resorcinol-succinein in argentometric titrations are described.

Two drops of the indicator (0·2 per cent. solution in alcohol) are sufficient for every 20 c.c. of the titration mixture. The following table shows the range of applicability of this indicator compared with Fluorescein in argentometry.

The new indicator, therefore, compares very favourably with fluorescein, and is definitely

Titration of	Fluorescein indicator (Titratable upto)	Resorcinol succinein (Titratable upto)
I^-	N/100 (accuracy 0·5%)	N/4000 (accuracy 0·5%)
Br^-	N/100	N/200
CNS	N/100	N/100
Cl^-	N/.00	N/20

more sensitive for iodide ions, in which case solutions of N/4000 can be titrated.

Titrations, as with other indicators of this class, are possible in neutral or just alkaline solutions but fail in acid solutions.

Chemical Laboratory, R. C. Mehrotra.
University of Allahabad, R. D. Tiwari.
March 12, 1947. H. L. Dube.

1. *Z. Electrochem.*, 1923, **29**, 495.

EFFECT OF STORAGE AND ACIDITY ON THE PROTECTION OF VITAMIN A IN SHARK LIVER OIL BY ANTIOXIDANTS

In an earlier communication,[1] it was reported that a combination of *iso*-butyl gallate and citric or tartaric acid affords a high degree of protection to vitamin A in fresh shark liver oil of low acid value (0·52), as judged by accelerated tests. The effect of antioxidants under normal storage conditions is reported here.

A sample of oil (B) of acid value 5·18, preserved in a refrigerator for about a year, was treated[1] with different concentrations of the antioxidants and stored at room temperature (18°–35° C.) in a number of ground-glass stoppered bottles (50 c.c.) painted black on the outside. The control oil as well as the treated oils were stored in triplicate. At regular intervals vitamin A was estimated[2] by the Carr-Price reaction using the Pulfrich Photometer with filter S. 61. The mean of the three values of each set is given in Table I.

Though the rates of fall of vitamin A are rather irregular, the beneficial effect of the antioxidants is obvious from the above table. In almost all the treated samples original

TABLE I

Period of storage in days	Control oil	Vitamin A expressed as $E^{1\%}_{1\,cm.}$ in oil with iso butyl gallate (G) and citric acid (C)						
		G(0·01%) C(0·005%)	G(0·02%) C(0·01%)	G(0·03%) C(0·015%)	G(0·04%) C(0·02%)	G(0·05%) C(0·025%)	G(0·06%) C(0·03%)	G(0·07%) C(0·035%)
0	6·86	6·86	6·86	6·86	6·86	6·86	6·86	6·86
30	6·21	—	—	—	—	—		
60	5·39	—	—	—	—			
120	4·44	6·86	6·86	6·86	—			
180	3·74	,,	,,	,,				
240	3·22	6·44	,,	,,	6·86	—		
300	2·86	6·05	6·51	,,	,,	6·86		
360	2·58	5·44	5·83	6·05	6·27	6·27	6·47	6·47
420	2·34	4·51	5·06	5·17	5·18	5·39	5·61	5·68
480	2·27	3·63	4·18	4·46	4·76	4·75	[illegible]	[illegible]
540	—	3·16	3·54	3·24	4·34	4·26	[illegible]	4·46
600	—	2·75	3·02	3·02	3·07	[illegible]	[illegible]	[illegible]

vitamin A content was retained upto ten months, whereas in the control oil about 10 per cent. vitamin was lost after one month and about 60 per cent. within ten months. However, once the deterioration started in the fortified oils, it went on almost with the same speed as in the control. The effective concentration of the antioxidants for the highest protection appears to be 0·04 per cent. *iso*-butyl gallate + 0·02 per cent. citric acid.

Since commercial samples of pure shark liver oil are found to have acid values ranging from 0·5 to 20·0 (occasional samples having as high as 26·0), it was thought desirable to study the effectiveness of the antioxidants on oils of different acidities.

Samples of varying acid values, that were stored in the refrigerator upto the time of experiment, were dried[3] by filtering through a column of anhydrous sodium sulphate and treated[1] with and without antioxidants. 1 c.c. of each of the control and fortified oils was stored at 40° C. in bottles (50 c.c.) fitted with rubber stoppers and sealed with rosin wax. At regular intervals, three bottles of each set were taken out, the oils contained in them were mixed together and vitamin A was estimated as before. The induction periods were determined as reported in the previous communication.[1] The results are summarised in Table II.

In two cases, from about 2 gms. of an oil of low acidity, the fatty acids were isolated[3] and added to 25 gms. of the same sample of oil in order to demonstrate the influence of increased free acidity on the degree of protection afforded by the antioxidants to oils of the same origin but of different acidities.

The results show that high free acidity not only adversely affects the keeping quality of the unfortified oil, but also lowers considerably the efficiency of the added antioxidants. This observation is of obvious importance from the point of view of the commercial utility of antioxidants. Freshly extracted oils of low acid value only (preferably below 1·0) respond to the action of the antioxidants studied. This again emphasises the importance of producing

TABLE II

Sample of oil	Acid value	Induction period (hours)		
		Control oil	Oil + Iso-butyl gallate (0·02%) + Citric acid (0·01%)	[illegible]
A	0·54	68	1034	14·2
A + Acids	10·87	60	522	7·7
B	5·18	56	[illegible]	8·9
C	0·81	72	1116	14·5
C + Acids	12·02	62	528	7·5
D	2·95	58	644	10·1
E	1·32	64	826	11·9
F	0·98	68	1006	13·8
G	1·86	62	750	11·1
H	19·37	28	178	[illegible]
I	14·36	44	[illegible]	5·9

shark liver oil of very low acidity, which can only be achieved[4] by using fresh or well preserved livers.

My grateful thanks are due to Mr. B. N. Banerjee and Prof. V. Subrahmanyan for their kind encouragement and keen interest in the work.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
April 3, 1947.

S. M. BOSE.

1. Bose, S. M., and Banerjee, B. N., *Ind. Jour. Med. Res.*, 1945, **33**, 203. 2. Dattatreya Rao, S., *Ibid.*, 1944, **32**, 155. 3. Idem., *Ibid.*, 1946, **34**, 91. 4. Dattatreya Rao, S., and Banerjee, B. N., *Ibid.*, 1944, **32**, 161.

EFFECT OF SPACING ON YIELD OF WHEAT

Gregory[2] has emphasized the importance of studying simultaneously the various factors governing crop production at different levels. The usefulness of work based on this idea has been amply demonstrated by Dastur and his co-workers[1] in the case of cotton under Indian conditions. In 1935 the present writer initiated studies on inter-relation of factors affecting the yield of wheat under irrigation as well as under the conditions of dry farming at the Godrej Farm, Nasik (unpublished work), and obtained striking increases in the yield of wheat by using a heavier seed rate (100 lb./acre) with 6-inch spacing of rows.

In order to confirm this important finding experiments were undertaken with a number of varieties of wheat during 1941-45* and the effect of a heavier seed rate was studied for dry and irrigated land. As the results appear to have some significance a brief summary is given here in the hope that the suggestion made here may prove useful in ovrcoming to some extent the present food shortage.

Each of the seven experiments given in the table of results was factorial in design with proper replication and randomisation. Only the effect of spacing is given here as it is intended to publish the details of these experiments elsewhere. The 'normal' seed rate varied from 60-80 lb./acre and the 'heavy' seed rate ranged from 90-110 lb./acre. Factorial experiments of 1935-36 had shown that a higher seed-rate increased the yield adequately only when it was distributed evenly in a greater number of rows per acre. It was therefore so arranged that in the normal seed rate the rows were spaced 10-12 inches apart, approximating to the usual practice of sowing behind the country plough, and in the case of the heavy seed-rate the distance betwen rows was 6-8 inches.

Table I. *Effect of closer spacing on yield of straw and grain (lb./acre)*

Seed Rate		1936 Irr.	1936 Irr.	1942 Dry.	1943 Dry.	1943 Irr.	1944 Dry.	1945 Dry.
'Normal'	(Straw)	701	1243	3106	1435	2685	4719	9122
	(Grain	302	644	1387	775	1667	1443	1822
	(Ratio)	2·32	1·93	2·24	1·85	1·61	3·27	5·00
'Heavy'	(Straw	973	1502	4374	1730	4126	6289	11154
	(Grain)	516	818	1876	931	2197	1803	2036
	(Ratio	1·89	1·84	2·38	1·86	1·88	3·49	5·48

It will be seen from the table that heavy seed-rate has increased the yield appreciably. The result is highly significant statistically in all cases. Russell and Watson[4] have shown that the usual seed-rate in Great Britain varies from 2 to 3½ bushels per acre with 6-inch spacing of rows. Considering this fact it is not surprising that increased seed-rate in the present case has given a higher yield. It is significant that increased yield is obtained by higher seeding rate even on irrigated land. Comparison of yields from dry and irrigated lands shows that higher moisture in the latter has given a significant increase in yield. Obviously, therefore, the seed-rate for wheat appears to be low as a general rule, and it is probably one of the main causes for the low level of wheat yields in this country. This becomes all the more clear when it is realized that the seeding rate in Great Britain is greater in spite of the heavy tillering habit of the English wheats.

The amount of tillering in wheat is not only dependent on the supply of water in the early stages of growth but also on the time of laying down of the rudiments of ears. Whether a crop is on dry land where tillering is restricted, or on irrigated land, considerable proportion of tillers cannot develop into ears because of the hastening of the ripening processes by unfavourable weather conditions especially temperature. In the former case an additional factor, *viz.*, increasing soil drought also causes considerable death of tillers. Studies of growth analysis of wheat at this Institute (unpublished work) also lend support to this view. Even in the case of early variety like I.P. 165 it has been observed that the ear-tiller ratio is 0·5 to 0·7. This ratio has been found to decrease progressively with the length of the vegetative period of different varieties. The potential yield of the plant is, therefore, not achieved.

Moreover root development under the conditions of dry farming is restricted, so that only with a dense stand of plants do the roots adequately explore the available root space. As the soil moisture is lost directly to the air by evaporation a greater proportion of it is made unavailable to the crop when the plants are widely spaced. Closer the spacing, therefore, the more economically is the available moisture used.

Straw yield will be largely determined by the amount of tillering of the plants. It appears from the straw-grain ratios that even with closer spacing (heavy seed-rate) of plants tillering has not suffered. Obviously, therefore, there was no overcrowding of plants. Describing wheat cultivation in Great Britain Percival[3] says that "it is found that increased tillering, rarely if ever, makes up for the reduction in the number of plants which thin seeding entails".

It is, therefore, clear that the seeding rate of wheat may profitably be raised to 100 lb./acre with 6-inch spacing of rows as a measure for increasing the yield.

Indian Agric. Res. Institute,
New Delhi, J. J. Chinoy.
February 25, 1947.

* During 1936-41 the writer was working in Punjab Physiological (Cotton Failure) Scheme of the I.C.C.C.

1. Dastur, R. H., *et al.*, *Indian J. Agric. Sci.*, **1943**, **13**, 610-30. *Ibid.*, 1944, **14**, 18, 181, 325. 2. Gregory, F. G., *et al.*, *Proc.* 1930, *Confer. Emp. Cotton Growing Corp.*, Pp. 112-130. 3. Percival, J., *Wheat in Great Britain*, 1943. 4. Russell, E. J., and Watson, D. J., *Imp. Bur. Soil. Sci. Tech. Comm.* 1940, No. 40.

PSEUDOSCORPIONS IN BEEHIVES IN INDIA

RECENTLY, a cheliferid (Arachnid) was noticed to occur in small numbers in beehives at Namkum, Ranchi. As far as the writers are aware, this appears to be the first record of a species of an arachnid inhabiting beehives in India. Although there are records of pseudo-scorpions occurring among bees in other parts of the world, the economic status of these creatures has not been investigated fully. Alfonsus[1] mentions *Chelifer cancroides* (the book scorpion) occurring sometimes in beehives in Germany, feeding on many species of mites, and suggests that this arachnid may prove to be of practical value in the control of acarine disease of bees. Hirst[2] records *C. sculpturatus* frequenting beehives in South and East Africa and says that 'there is no real parasitism, and insect hosts are used merely as means of transport, the chief food being mites'. In a foot-note following this paper, Mr. R. Whyte, a bee expert, questions the harmlessness of these pseudoscorpions among bees, as he noticed the young arachnids, while refusing honey or pollen, sucked up the juices of bee larvæ that had been injured in removing them from cells. Orosi Pal[3] observed *C. cancroides* preying on larvæ of the wax moth, *Galleria mellonella* L., in Germany.

The full grown cheliferids, we have come across, are dark chestnut brown in colour, flattened, ovate, about 3·5 mm. long and with prominent pedipalps which are longer than the body itself. The pedipalp is provided with two finger-like joints for clasping. The cheliferids are capable of running swiftly, and usually move their pedipalps in the air, when excited. Different stages of this cheliferid have been noticed together in the same hive, mostly resting on the frames among the worker bees. They seem to shun light, as they are found to retreat under the frames, on opening the hive. They cling firmly to the legs of bees with the help of their pedipalps and thus get themselves transported. It is not an uncommon sight to find worker bees carrying about these arachnids attached to their legs. Not more than one cheliferid is found attached to a bee.

In the laboratory, the arachnid readily attaches itself to the leg of the bee, and in one instance it tried to feed by applying its mandibles in between the joints of the leg of the bee. In this case the bee appeared to be excited considerably. When supplied with medium-sized wax-moth larvæ, they fed on them by holding the caterpillars with their pedipalps. In one case, when a wax-moth larva and a worker bee were provided in the same cage, the arachnid preferred to attach itself to the leg of the bee, although it was starving. Cannibalism is quite common when different stages are caged together. It was interesting to note that hives harbouring these arachnids were free from wax-moths and mites.

The habits of these cheliferids are being studied, and the results will be published in due course. This note is intended to invite the attention of bee-keepers in India to these creatures, which if proved harmful, will be a menace to bee-keeping in India.

J. N. SINGH.
T. V. VENKATRAMAN.

Division of Entomology,
Indian Lac Research Institute,
Namkum, Ranchi,
September 19, 1946.

1. Alfonsus, A., "Bee World," Benson Oxon, **4**, 2-3 (Abstract in *R.A.E.*, 1922, **10**, 448). 2. Hirst, S., *Ibid.*, 36-37 (Abstract in *R.A.E.*, 1922, **10**, 491). 3. Orosi Pal, Z., *Z. angew. Ent.*, 1938, **25**, Pt. 1, 142-150 (Abstract in *R.A.E.*, **26**, 661)

OCCURRENCE OF *MYCTOPHUM* SP IN BOMBAY HARBOUR*

Two post-larval forms of *Myctophum* sp. were found in a plankton sample from the Bombay Harbour on the 15th September 1944. One of the specimens measured 6·5 mm. and the other 14 mm. They had distinct photophores on the body arranged in rows (Fig. 1).

Myctophum sp. × 6

This luminous fish, to our knowledge, has not been described or reported previously from Bombay Waters. It is noteworthy that it was found only once in our plankton collections during the last ten or twelve years; it appears to visit the coast rarely, being perhaps a deep sea form.

Our specimens differ from *Scopelus indicus*, a single specimen of which was collected by Sir Walter Elliot at Vizagapatam and recorded by Day.[1] The publication of this note was postponed with a view to securing more material for the final identification of this species. Unfortunately identification has to be deferred as the forms did not occur for the second time in our collection.

Department of Zoology, The Royal Institute of Science Bombay,
March 17, 1947.

D. V. BAL.
L. B. PRADHAN.

1. Day, "The Fauna of British India, Fishes," 1889, **1**.

* Specimens occurred in the material collected for the research scheme carried out under the Imperial Council of Agricultural Research, New Delhi, and the Government of Bombay.

ON THE OCCURRENCE OF SCLEROSED PALISADE CELLS IN THE LEAF OF *NYCTANTHES ARBOR TRISTIS* L.

SYSTEMATISTS depend chiefly on the floral characters to distinguish one family from the other. Since the progress of anatomical research ample testimony is coming to show that anatomical characters too offer important

diagnostic clues in the identification of families. In the present case, namely, the investigation of sclereides in many genera and species of Oleaceæ shows that these structures are typical and distinguishing features of this family.

The term Sclereid, meaning a hard protecting cell, is often used as synonyms with stone cell. The presence of Sclereids in the mesophyll has been reported in some members of Oleaceæ, Ternstrœmiaceæ and Capparidiaceæ, etc. Their presence is said to stiffen the leaf and according to Stevens (1924) they give hardness and toughness without being an impediment to increase in size.

The occurrence of elongated Sclerosed palisade cell or Astrosclereid seems to be very characteristic of the Oleaceæ by which it can be readily distinguished from allied families. In this paper a short account of the occurrence of Sclereides within the matured leaves of *Nyctanthes arbortristis* L. is given.

Leaves are bifacial. The mesophyll is differentiated into palisade and spongy tissue. The noteworthy feature of the palisade parenchyma is the possession of Sclerosed palisade cells. Unlike the other members of the family where they show very varied types of differentiation, starting from columnar Sclerenchymatous cells to highly branched Sclerenchymatous fibres, the Sclerosed palisade cells of *Nyctanthes arbor iristis* are short rod-like cells deprived of any growth. They lie either in isolation or loosely together *in situ* or sometimes a few cells in both the rows get converted into stone cells (Fig. 1). In the latter case they lie one above the other without being connected. One noteworthy feature of the Sclereides in their rod-like stature with thick lignified wall leaving a narrow lumen within the cell.

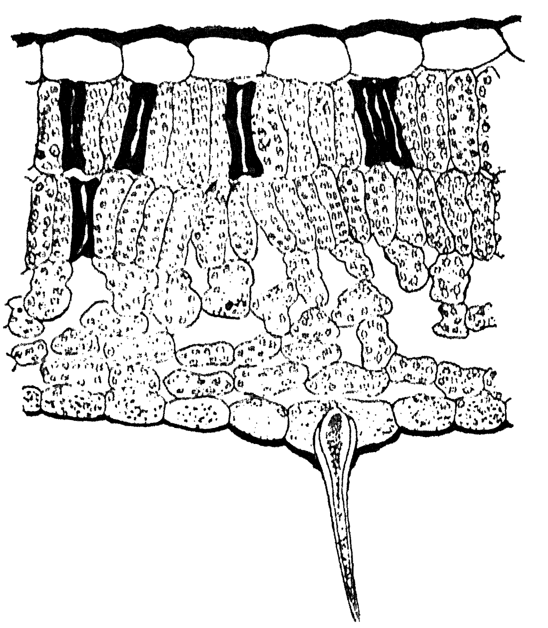

FIG. 1. Transverse section of leaf showing Sclerosed Palisade Cells.

Several instances of elongated columnar Sclerosed cells traversing the mesophyll have been recorded by Vesque and Pirotta (Boodle and Fritsch, 1908) in several species of Olea, Linocera and Noronhia. That Sclereid is the transformed palisade cell has been shown in *Olea dioica*,[1] where they traverse the mesophyll irregularly. The same feature is seen by the author in *Olea glandulifera*, *Olea europea* and *Olea cuspidata* and *Olea polygama* (detailed account will appear elsewhere).

The occurrence of short rod-like sclerosed palisade cell without the power of growth in *Nyctanthes arbor tristis* is really very interesting. Thus these Sclereides form an intermediate stage between those non-lignified palisade cells and elongated columnar sclerosed palisade cells.

My thanks are due to Dr. M. J. Thirumalachar for guidance and to Prof. L. N. Rao for his encouragement.

Department of Botany,
Royal Institute of Science,
Bombay, T. ANANDA RAO.
January 23, 1947.

1. Krishnaswamy, B. L., *Curr. Sci.*, 1942, **11**, 4. 2. Solereder's Systematic Anatomy of the Dicotyledons. Translated by L. A. Boodle and F. E. Fritsch Oxford University Press, 1908. 3. Stevens, W. C. *Plant Anatomy*, London, 1924.

NATURAL ACCLIMATISATION OF TWO SPECIES OF MULLETS *MUGIL DUSSUMIERI* (C V.) AND *MUGIL OEUR* (FORSK.) TO FRESHWATER CONDITIONS ON THE NELLORE COAST[1]

GRADUAL acclimatisation of certain Indian Marine and estuarine species of Mullets to freshwater has recently been reported by Devanesen and Chacko,[2] and Venkataraman.[3] They collected fry from the sea and gradually lowered the salinity by replacing a quantity of salt water with freshwater daily. Thus within 3 to 5 days Devanesen and Chacko were able to acclimatise Mullet fry for stocking in freshwater tanks. Venkataraman found a prolonged course of 12 days suitable for *Mugil seheli*.

During the 1943 and 1944 seasons experiments were conducted at Woolapaliem in Nellore District. Swarms of Mullet fry were observed to shoal about the estuarine area about full moon and new moon periods (4 days before and after spring tides) during the months of November to February the peak period being December and January.

The fry ascending the creeks with the rising tide were prevented by certain bunds from entering into freshwater courses. By cutting a passage the salt water from the creek and sweet-water from the fields were connected by a narrow neck. The fry then climbed upstream and remained sufficiently long in 'sweet-water' indicating their voluntary adjustment to complete freshwater under favourable temperature and pH of 79° F. and 8·1 respectively. When completely acclimatised in their natural ascent into freshwater the fry

were trapped in a compartment of freshwater by placing two closely-meshed bamboo lattices across the stream. The fry were later transferred to a conditioning box by means of a fine-meshed hand-net. 30,700 Mullets of the above two species were thus collected in the course of one month and transplanted in 14 tanks in Nellore and 12 in Kistna Districts. The maximum mortality during the entire process was 5 per cent.

It is clear from the above experiment that it is easy to collect on a large scale and transplant these naturally acclimatised Mullet fingerlings without any elaborate conditioning. The mortality is low and the fry stand transport admirably well. The creeks at Wollapaliem thus afford excellent collection grounds for the fingerlings of *Mugil dussumieri* and *Mugil œur* which like other Mullets can considerably augment freshwater pisciculture.

Pearl and Chank Fisheries,
Tuticorin, V. D. SPURGEON.
March 25, 1947.

1. Published with the permission of the Director of Industries and Commerce, Madras. 2. Devanesen, D. W., and Chacko, P. I., *Pro. Nat. Inst. Sci. India*, 1943 **9**, 249. 3. Venkataraman, R. S., *Curr. Sci.*, 1944, **14**, 239.

ON THE OCCURRENCE OF *SQUILLA HIEROGLYPHICA* KEMP (CRUSTACEA, STOMATOPODA) IN THE COASTAL WATERS OF TRAVANCORE*

Squilla hieroglyphica was briefly described by Kemp[1] in 1911 from a single female specimen measuring 53 mm. in length, from an unknown locality. In his later monograph he gave a more detailed description of the species, but was unable to give any particulars about the provenance of the specimen, beyond stating that there was little doubt that it had been found within the Indo-Pacific region. The type-specimen (No. 7327/10) is preserved in the collections of the Zoological Survey of India and bears a "no-history" label. The species does not appear to have been recorded since the publication of Kemp's original description.

In the course of my researches on the "Bottom Fauna and Bottom Deposits of the Travancore Coast within the 15 fathom line", I obtained a male specimen of *S. hieroglyphica* measuring 61 mm. from the Trivandrum Coast at 12 fathoms. The sea bottom in this region is mostly composed of fine black sand with a small percentage of mud, shells and shell-fragments. The specimen agrees closely with Kemp's type-specimen and description of the species.

As stated by Kemp,[2] the nearest ally of *S. hieroglyphica* is *S. lævis* Hess from New South Wales; but, apart from other characters, the two species can be easily distinguished from one another by the presence of five teeth on the raptorial dactylus in the former and of six in the latter.

The colouration of *S. hieroglyphica*, as described by Kemp, appears to be very characteristic. The exact colour pattern of my specimen unfortunately was not noted at the time of collection and though the general colouration is more or less as described by Kemp, the distribution of black chromatophores cannot be easily made out. Traces of dark pigment spots are, however, visible on the carinæ and the dark chromatophores on the telson can also be faintly seen. The whole colour pattern appears to have faded, and the three pigment spots on the eye stalks, mentioned by Kemp, cannot be made out.

I am thankful to Dr. B. N. Chopra, Director, Zoological Survey of India, for helping me in identifying the specimen and for the necessary facilities in the laboratories of the Zoological Survey.

Marine Biological Laboratory,
University of Travancore,
Trivandrum, C. V. KURIAN.
December 20, 1946.

* Published from the Zoological Survey of India.

1. Kemp, *Rec. Indian Mus.*, 1911, **4**, 96. 2. —, *Mem. Indian Mus.*, 1913, **4**, 51.

PERITROPHIC MEMBRANE IN *SCHISTOCERCA GREGARIA* FORSK THE DESERT LOCUST

THE peritrophic membrane in *Schistocerca gregaria* Forsk. is formed primarily as a single layer by bands of epithelial cells situated a little posteriorly to the anterior limit of the mid-gut while the striated cells of the mid-gut epithelium along its entire length assist in the formation of loosely connected rather concentric lamellar portion of the peritrophic membrane.

In the ventricular part of the alimentary canal, fixed in Bouin's Fluid, the anterior region of the mid-gut containing the band of epithelial cells can be clearly made out when the gut-contents have been thoroughly removed. The œsophageal valve does not extend far enough into the mid-gut to act as a so-called "press" for the peritrophic membrane. In fact the valve does not reach upto the band of epithelial cells.

It seems possible that in those Acridiids in which the bands of cells in the anterior portion of the mid-gut is present, the membrane is formed partly by the band of epithelial cells of that region as a single lamella and is reinforced by the peritrophic membranes produced as detached layers by the striated secreting epithelial cells of the entire mid-gut. In the insects in which this anterior band of epithelial cells is absent, the general striated epithelial cells of the mid-gut secretes the membrane. The formation of the peritrophic membrane takes place apparently when the normal secretion of the cells is inhibited at the time of feeding.

A detailed work on this line will be published elsewhere later.

Division of Entomology,
Indian Agricultural Research
Institute, New Delhi, S. MUKERJI.
January 14, 1947.

REVIEWS

The Anatomy of Lango Religion and Groups. By T. T. S. Hayley. (University Press, Cambridge), 1947. Pp. 207. Price 21*sh.* net.

In these days when nationalism is considered and evaluated to be the supreme political virtue, especially by groups and communities that had been and that still continue to remain under the rule and domination of foreigners, the theory or doctrine that these much vaunted nationalistic tendencies are responsible for frequent conflicts and clashes among different sections of mankind, and very often the cloak of Nationalism is successfully used to hide and cover a multitude of sins, may seem not only strange, but, may provoke a lot of opposition. Nevertheless, if a strictly psychological analysis of the constituents of loyalty to groups, and concomitant contributory factors be undertaken it is bound to be crystal-clear that such a loyalty like many other loyalties is just based and grounded on the inseparable twin-instincts of self-preservation and reproduction, though such a judgment may wound the *amor propre* of *homo sapiens*. Though on account of the undoubted anatomical and physiological advantage which man has over the animal creation, and particularly on account of the structure and function of the cerebral cortex which marks a particular stage in the evolutionary series, and development of the power of reason, mankind has been able to subdue and subordinate animal instincts to those well known higher intellectual and cultural needs satisfaction of which has made group- or community-life possible, still study of primitive group-life would demonstrate the inherent impossibility of any organization like a world-state or world-nation, or the Parliament of man envisaged in rosy dreams of poets. Some such will be the irresistible conclusion to which readers will arrive if they should make a careful study of the volume under notice by Mr T. T. S Hayley, Director of Publicity and Rural Development to the Government of Assam, who has undertaken a sustained and systematic account of the main customs, manners, beliefs, religion and rituals of the inhabitants of Lango District (Uganda) with a view to placing the primitive group amidst anthropological setting and perspective. In the course of a brief "Foreword", the author explains the circumstances of the origin of the work and points out that in the complicated network of the religious ceremonies lies the cohesive and cementing force that keeps the groups together, and group-loyalty and inter-group-loyalty would seem to rest on religious emotionalism. The opening chapter is devoted to a descriptive study of the "Lango Religion and Magic". The premises, or assumptions, or postulates of the Lango Religion are stated, and then the practice of "White Magic" and "Black Magic" is described. In the second chapter, the author has described in fairly elaborate detail the "ceremonies" relating to different Lango "Groups". The "Ceremonies" concerning the "Tribe" are narrated in Chapter 3. Likewise, the other ceremonies relating to or concerning the "Clan" the *Etogo*, the "Family", "Territorial Groups", and "Medicine men", are described in a graphic manner with an eye on precision of detail and loyalty to the original ritualism. There is a full and exhaustive Glossary and Index of most of the important and significant characteristic terms that have entered into the constitution of the complicated network of the language of the Lango.

Within the limits of a notice like this, I have given in the previous paragraph a fairly full epitome of the main contents of the volume and it is noteworthy that Mr. Hayley has been quite successful in securing and imparting maximum verisimilitude to his portraiture of the odd customs and ceremonies of the Lango, as he has used in the course of his description several of the leading and key-terms of the Lango language in the original. These terms have been explained in the "Glossary", and one can admit without hesitation that after Driberg's work *The Lango*, Mr. Hayley's volume is bound to rank as the most outstanding which makes a valuable and distinctive contribution to a correct understanding of the nature of the life lived by the Lango.

As a close student of Indian and European and American contribution to Psychology, I easily realize that the conclusion arrived at by Mr. Hayley, that in the development of group-awareness and group-consciousness, and in the gradual crystallization and stereotyping of lines of group-behaviour, religious rituals and ceremonies play the most prominent part, is most unexceptionable and anthropologically sound and well-established. The instinct of self-preservation is active and dynamic not merely in individuals, but in groups, clans and tribes and larger units as well, and when a group is attacked or threatened with alien aggression, it naturally reacts in a characteristic manner fortifying itself against such external aggression. Be it in the Hitler Youth Movement of civilized Nazi Germany and the Third Reich, or, in the *Etogo* of the Lango, beyond the pale of advanced European Civilization, it is some specific form or pattern of religious ritualism and symbolism that would appear to generate, engender, and bring about the group-consciousness and group-awareness and group-loyalty.

There is no need to endorse the view of Mr. Hayley that man is social only by "necessity" and that mankind is not particularly anxious to see "world-brotherhood" established, as man's gregariousness and sociological-grouping-behaviourism may now be claimed to be grounded on psychological evidence, and as "world-brotherhood" has always been linked up with the spiritual call proclaimed by great world-teachers. It is,

however, an undeniable fact that though frequently applauded as a political virtue nationalism is bound to be narrow and circumscribed in outlook, in general ideology and in practice of government and other relationistic adjustments, and the suggestion made by Mr. Hayley that the task of maintenance of international peace should be entrusted to a body of persons "specially trained from birth in loyalty to a non-national ideal", is logically and psychologically the soundest, though it is bound to be dismissed as Utopian by modern politicians who are congenitally and constitutionally unable and incapacitated to see beyond their own NATIONAL NOSES as it were, and whose conduct is still moulded and patterned in the light of the frequently-heard slogans—"My country—right or wrong", "My nation—right or wrong". It is all a long, long way off. Leaders of international thought must be chosen from amongst those who from childhood should have been psychologically and behaviouristically conditioned into loyal adherents of a non-national ideal based on recognition of the sacredness of mankind or humanity as a whole. Till such a non-national ideal inspires rational human conduct, it is inevitability itself that a Pearl Harbour Treachery should elicit the necessary retaliation in the shape of the Atom-Bomb.

Quite apart from that ideal, Mr. Hayley has drawn a striking and arresting picture of the rituals and ceremonials relating to white and black magic of the Lango, and his account vividly demonstrates that the forces responsible for group-consciousness are religious forces. If beliefs and faith in old religion and religious practices are rudely and violently shaken with the advent of modern education and with the domination of reason, rationalism, and critical analysis, etc., *pro tanto*, the different groups may tend in the direction of disintegration.

Mr. Hayley may be interested to know that the superstitious beliefs relating to ill-omened character of abnormal births (like children with teeth), etc., recorded on pages 3 and 176, find their analogues or counterparts in the beliefs and superstitions of Hindu Brahmins entertained even to-day. Thus, if a new-born baby violently and hysterically laughs, it forebodes inevitable danger to the mother. The owl is not after all as bad as the Lango would have us believe. If an owl, or a kite, should perch on the roof, an evil-nullifying or evil-counteracting ceremony has to be performed (*Śanti*). I have no doubt that students of sociology and anthropology would find the volume of Mr. Hayley exceedingly well-written, scientifically documented, and thought-provoking. Thirteen plates and a map of the Lango district add to the usefulness and attraction of the volume.

R. NAGA RAJA SARMA.

Nuclear Physics Tables. By J. Mattauch; and **An Introduction to Nuclear Physics.** By S. Fluegge. (Interscience Publishers, Inc., New York), 1946. Pp. 174 and VIII plates. Price $12.00.

Since the publication of the *Elements of Nuclear Physics*, by Rasetti in 1937, no good text-book on nuclear physics has appeared in spite of the fact that the subject has expanded notably in recent years. The need for a book covering the whole field of nuclear physics including recent developments in the subject has been very keenly felt. Besides, the rapid increase of literature in experimental nuclear physics makes it impossible for every physicist working in this field to keep track of the large amount of material without the aid of an up-to-date and comprehensive reference file. Both these needs are catered for to a great extent by the publication of the book under review which brings up to date (*i.e.*, up to the end of 1941 when the book was first published) all the available information in this rapidly changing field.

The book is divided into two Parts. The first part, written by Fluegge, is a concise, self-contained and well-digested survey of the fundamental problems in nuclear physics with special reference to experimental methods and results. This forms a pertinent introduction to Part II of the book which is a compilation of nuclear physics data. Part I is divided into four sections:—(1) Stable nuclei, (2) Nuclear reactions, (3) Unstable nuclei and (4) Systematics of stable nuclei. The methods used for the measurements of mass defects, nuclear masses, relative abundance of isotopes, nuclear spin, nuclear magnetic moment and the quadrupole moment have been critically reviewed in Section I. Various aspects of the problem of nuclear reactions such as methods of observation, sources of radiation, range-energy relation, conservation of energy and momentum and yield have been discussed in some detail in Section II. The properties of natural radioactive bodies and the different processes of disintegration of unstable nuclei of both the natural and artificial radioactive elements are described in Section III. The fundamental subjects of K-capture, isomerism and meson theory of nuclear forces are included in this presentation for the first time. The last Section contains a short account of the existence and abundance rules fulfilled by stable nuclei and also of the binding energy of atomic nuclei.

The second and the more important part of the book consists of a set of six nuclear physics Tables and eight nuclear physics Plates, compiled by J. Mattauch. The nuclear physics data collected from well over a thousand original papers have been classified and presented in a tabular form which enables one to locate quickly all the literature concerning any question. The Tables deal with the following subjects:—(*i*) Properties of stable nuclei, (*ii*) Maximum possible abundance of probably non-existent nuclei, (*iii*) Mass-spectrographic measurement of doublets, (*iv*) Survey of known nuclear reactions; properties of artificially radioactive nuclei; (*v*) Supplement to Table IV and (*vi*) Energy release in nuclear reactions. Tables I-III form a group and contain observed data on stable nuclei (Section I of Part I). Tables IV-VI form a second group devoted mainly to nuclear reactions and the observed data on unstable nuclei (Sections II and III of Part I). The two groups of Tables are provided with separate bibliographies.

Tables I and IV are exhaustive. The former contains data on the atomic number, mass number, number of neutrons, spin, magnetic moment, relative abundance, packing fraction and mass defect of all the naturally occurring isotopes of elements and also of the α-active elements of the disintegration series. Table IV, on the other hand, contains the list of stable and unstable nuclei so far as they were known till the end of 1941 (year of first publication) together with their half-period values, terms and energies and the nuclear reactions carried out among them. This table permits one to obtain at a glance the initial isotope and the reactions which lead to a given nucleus as an end product and conversely to see which nuclei could be obtained from a given initial isotope, by what kind of reactions. The numerical values of Q, the reaction energy, of over a hundred nuclear reactions among low atomic weight elements have been listed in Table VI.

Of the eight nuclear physics Plates, the first shows graphically the packing fraction and mass defect of elements as functions of mass number, A. Plates II-VIII give a representation in the N-Z diagram of the known atomic nuclei together with the percentage abundance and the half lives. The types of decay and the nuclear reactions carried out among them are presented in a four-colour graphic scheme which permits any possible reaction to be followed up with great ease.

In the preparation of this book the authors deserve to be congratulated for presenting in one volume a concise introduction to nuclear physics and a complete listing of numerical values of the properties of stable and unstable nuclei and of all the known nuclear reactions. The printing and get-up of the book are excellent. The book was first published in Germany in 1942 and the present volume is an English translation of the same. As such, the results of papers in nuclear physics which appeared after the year 1941 are not included in the Tables. In spite of this limitation, the book is extremely useful and the numerous workers in the field of nuclear physics will find this volume very handy and indispensable.

R. S. KRISHNAN.

X-Rays in Research and Industry. By H. Hirst (Chapman and Hall, Ltd., 37, Essex Street, London, W.C. 2), 1946. (Second Edition.) Pp. 124. Price 13*sh*. 6*d*.

The varied and versatile applications of X-rays to problems of interest in research and industry, especially in physical metallurgy have been dealt with in a simple, concise and objective manner in this handy little book. The first two chapters deal with the generation and properties of X-radiation. A brief description of crystal structure and of the principle of the diffraction of X-rays by the crystal lattice is contained in Chapter III. These three short chapters, though of an elementary nature, form a pertinent introduction to the methods of X-ray analysis used in research especially in crystallography which are described in Chapter IV. After discussing the Laue and the rotating crystal methods of examination which are applicable to single crystals, the author describes in some detail the powder method which is applicable to polycrystalline specimens and is, therefore, the most widely used of the different methods of examination. The advanced stages in the analysis of crystals have also been briefly indicated.

The second half of the book is devoted mainly to the applications of the X-ray method in the investigations of metallurgical problems relating to alloy systems. Effect of atomic distribution on the properties of alloys, identification of new phases, estimation of grain size and anisotropic behaviour of deformed metals and alloys are some of the prblems dealt with in Chapter V, for the elucidation of which X-ray methods have been successfully used. The last chapter describes the equipment used in industrial radiography and the principles of radiographic examination. The varied applications of radiography in the examination of castings, forgings and welds and to manufacturing problems in metallurgical industries are summarised in this chapter.

The book is profusely illustrated and is equipped with a comprehensive bibliography and should prove to be a welcome companion to crystallographers and more especially to metallurgists.

R. S. KRISHNAN.

The Mechanisms of Reactions at Carbon-Carbon Double Bonds. By C. C. Price. (Interscience Publishers Inc., New York), 1946. Pp. 118 plus index. Price $2.50.

The book under review is in the series "Lectures on Progress in Chemistry". The comprehensive title for the book is misleading and one learns from the Introduction that we have only "the personal aspect and specific approach of the author".

The contents can be broadly divided into two sections, the first one dealing with reactions at the double bond and the second with polymerization. A review may not be the place for any detailed analysis of the matter presented, but one cannot help remarking that the first three chapters give the impression of a rather one-sided version of the problems by a critic of the resonance theory in its application to organic structures and reactions. The greater part of the first chapter is devoted to benzene derivatives and includes a useful account of Dr. Price's approach in calculating the polarizing force of substituted benzene derivatives in the different positions as well as the overall effect. One noticeable feature is the consistent use of the symbol for equilibria $\rightleftharpoons$ instead of the double-headed arrow $\leftrightarrow$ commonly used to indicate resonance between various valence-bond structures where necessary. Wheland's monograph on Resonance, which the author refers to, explicitly draws attention (*vide* p. 6) to the distinction between the two symbols.

The next two chapters represent rather superficial accounts of half a dozen reactions of olefines and a similar number of free radical reactions. The treatment is essentially qualitative and the picture presented is often incomplete.

The author is obviously more at home with the second, shorter section; and a student gets a good bird's-eye picture of the various aspects of polymerisation, polar and free radical polymerisation, co-polymerisation and polymerisations in a heterogeneous phase.

Based on a course of lectures before the Institute of Polymer Research, the volume presents a useful account of one aspect of the problem of olefin reactions, and is quite suggestive in parts to an advanced student. The reviewer, however, cannot recommend this to an undergraduate seeking an unbiased critical account of the topics. The author himself rightly remarks in the preface, 'no pretense is made that the subject has been given the thorough treatment ...'

The print and get-up of the book are of a standard that one has come to expect of its publishers.

S. V. ANANTAKRISHNAN.

Goethe's Botany. By Agnes Arber. (*Chronica Botanica*, Vol. 10, No. 2, pp. 63-126, pls. 23-26.) (Published by the Chronica Botanica Co., Waltham, Mass., U.S.A.), 1946. Price $2.00.

Goethe's *Versuch die Metamorphose der Pflanzen zu erklaren*, published in 1790, is one of the minor classics of Botany. Estimates of the worth of this work differ radically. It has been often subjected to strong criticism, particularly in recent times. Yet, none can deny a good share to the *Metamorphose* in the advancement of plant morphology and the inspiration that later workers have derived from it. It is a striking tribute to the many-sided genius and creative insight of Goethe that a great deal of what he wrote more than 150 years ago is still accepted by a large majority of botanists and forms the basis of botanical teaching even to-day.

An English translation of *Metamorphose* by E. M. Cox with explanatory notes by M. T. Masters, first appeared in the *Journal of Botany*, Vol. I, pp. 327-45 and 360-74, in 1863. Another version was published recently in America in the *Notes and Correspondence of the Anthroposophical Agricultural Foundation*, Vol. 4, No. 8, 1937. However, both of these are difficult to get, the first on account of its age; the latter on account of the limited circulation of the Journal in which it has been printed. A new translation by a morphologist of the standing of Mrs. Arber and published in a handy form in the widely-circulated *Chronica Botanica* is, therefore, very welcome at the present time, when the morphology of the flower is arousing so much interest.

The little monograph is roughly divisible into three parts. It opens with a long introduction, in which the translator has critically appraised Goethe's contribution to science in general and Botany in particular. This is followed by the English version of the *Metamorphose*, with a large number of explanatory footnotes. And finally, we have the famous ode, the "Fragment", afterwards known as "Die Natur", whose authorship is disputed between Goethe and Tobler. Both the original German text and the English translation of the ode are given.

A. C. J.

Characterisation of Organic Compounds. By F. Wild. Cambridge University Press, Cambridge, 1947. (Agents for U.S.A., Canada and India: Macmillan & Co.) Pp. 306. Price 18*sh.* net.

The routine procedure for the identification of an unknown organic compound comprises tests for elements and typical groups present and determination of the physical constants. The final characterisation can, however, be made only by applying what is called the confirmatory test which generally involves the preparation of suitable derivatives and their examination. Although there are a number of standard books on qualitative analysis of organic compounds, there seems to have been none so far dealing mainly with the practical details for the preparation of characteristic derivatives. The book under review fills this gap by summarising the several methods which are used for the characterisation of organic compounds, presenting selected methods in detail and giving literature references for others which are useful for specific substances, covering the literature to the end of 1943.

Of the eleven chapters contained in the book, the first two deal with (1) the considerations that influence the selection of a reagent for the preparation of a satisfactory derivative and (2) the various tests for the classification of organic compounds and their separation from mixtures. The succeeding nine chapters deal with the methods for characterisation, mostly by the preparation of suitable derivatives, of the following classes of compounds, *viz.*, Hydrocarbons: Paraffins, *cyclo*-paraffins and aromatic hydrocarbons; Halides: Alkyl and aryl halides and polyhalogen compounds; Compounds containing the hydroxyl group: Alcohols, phenols, enols and carbohydrates; Mercaptans, thiophenols and ethers; Carbonyl compounds: Aldehydes, ketones and acetals; Acids: Carboxylic, sulphuric, arsonic and amino-acids, acid halides, acid anhydrides, esters, amides and imides; Amines and amino-compounds; and Nitro, cyano, nitroso, azo, azoxy and hydrazo compounds. In each of these chapters, the relevant reactions or suitable derivatives helpful for characterisation of each class of compounds are enumerated and experimental details, with full references to original literature, are given. Reference tables containing the physical constants for important substances and their derivatives are included at the end of each chapter. While literature references for the preparation of all the necessary reagents have been incorporated, a few of the preparations are given in detail in the text. There are an author index and an exhaustive subject index.

The book is handy and well got up. The material has been carefully collected and critically presented. This should be a welcome addition to the practical books for Honours Course students and research workers in organic chemistry.

B. H. IYER.

The Physico-Chemical Mechanism of Nerve Activity. By David Nachmansohn, Charles M. Berry, Oscar Bodansky, Frank Brink, Jr., Detlev W. Bronk, M. Vertner Brown, C. W. Coates, R. T. Fox, J. C. Eccles, Alfred Fessard, J. F. Fulton, R. W. Gerard, Alfred Gilman, D. E. Green, Joseph C. Hinsey, Rudolf Hober, Martin G. Larrabee and Tracy J. Putnam. (Published in the *Annals of the New York Academy of Sciences*, Vol. XLVII, Art. 4, pp. 375-602.)

This volume presents an illuminating series of papers about the acetylecholine system. The first paper, by Hober, deals with the membrane theory of excitation, and views to accommodate the recent findings on the values of action potentials are given. In the second paper, Nachmansohn discusses the chemical mechanism of nerve activity, and the importance of cholinesterase. In the third paper, Eccles discusses the electrical and chemical theories of transmission across junctions, and selects the former as being more adequate to explain recent findings, and presents a working hypothesis which offers a satisfactory explanation of many fundamental observations of synaptic transmission, irreversibility, of synaptic delay, time course of junctional potential, brief impedance loss at end plates, dorsal root potentials of the spinal cord, some of which were hitherto inexplicable in detail. The next few papers deal with the chemical excitation of nerve, electric characteristics of electric tissue of certain fishes, comparing the electric discharge with the action potential, the importance of enzyme action forming a basis of physiological responses, kinetics and other properties of cholinesterase action, effects of drugs on nerve activity and the properties of regenerating nerves. In the last paper, Gerard gives a masterly summing up of the present position of the role of acetylecholine in relation to nerve metabolism and function and suggests that acetylecholine may extend further and have more importance in cell functioning than has yet been seriously considered and that any particular role it plays in transmission is a secondary and derivative one.

INDERJIT SINGH.

Developing Village India. Studies in Village Problems. Special Number of *Indian Farming*, 1946. (Published by the Imperial Council of Agricultural Research, New Delhi.) Pp. 291. Illustrations 144 including 118 plates.

This is a remarkable volume and the first impression upon the reviewer is one of unstinted admiration for the extraordinary care which has been expended in its preparation, and even more for the evidence it reveals of wholehearted devotion to the welfare of the village population of India.

The publication is under the guidance of an Editorial Committee of well-known and responsible officials. The Editor is U. N. Chatterjee, D.Phil., D.Sc., F.N.A.Sc.

After a short general introduction concerned with aims and methods the volume is divided into eight sections: 1. Organization, 2. Publicity and Propaganda, 3. Agriculture and Nutrition, 4. Animal Husbandry, 5. Horticulture, 6. Cottage Industries, 7. Health and Sanitation, 8. Education and Culture.

All of these sections have their subdivisions each contributed by its separate specialist author. The articles are throughout liberally illustrated by excellent photographs reproduced on full pages of strong highly glazed paper. There has been no mistaken economy in this respect such as is sometimes observable in Government publications resulting in an impression of dullness and cheapness with consequent loss of interest.

The best which the reviewer can do is to bring before the reader the outstanding features of the book, to mention items which have particularly attracted his notice and to offer such comments or emendations as may serve a helpful purpose.

By no word would he wish to blur in any degree the vision which is evidently present in the minds of the writers.

He is the more happily impressed inasmuch as many ideas and proposals which he himself put forward now more than twenty years ago* and which the war years have in large measure held up from development will now have the backing of this widely circulated volume.

In his illuminating preface Sir Datar Singh points out that for centuries the Indian peasant has suffered from inhuman toil and drudgery. The time to repaint the picture has come. Besides the replacement of primitive agricultural and industrial methods by more modern and scientific technique and outlook, village art, folk songs, music and dance must not be forgotten since here will be formed the windows into the enduring spiritual life of the people.

At the outset in the Section on Organisation we are confronted with the problem arising from the statement that the work of two such devoted enthusiasts as Mr. F. L. Brayne and Mahatma Gandhi has ultimately failed, that after a temporary awakening due to the remarkable activity on the part of the protagonists and their followers the village community sinks back into its age-old sleep.

It would seem that however zealous and untiring the individual may be, so long as the effort is purely personal, the results disappear when the individual is removed from the scene. The "consciousness" of the villager has not been changed. For this to happen something more fundamental is necessary, which reaches deeper than merely personal example or precept. It must be able to penetrate the hard core of conservatism; based on thousands of years of prevailing social and agricultural practices. There must be no suspicion of personal or political background. Rather should

* *The True Path for Indian Industrial Development.* Paper read at the Benares Meeting of the Indian Science Congress, Jan. 1925.

Industrial Possibilities of Some Research Work Done in India. Based on two lectures sponsored and republished by the Society of Biological Chemists, India-Bangalore, 1934, Price Re. 1.

be present something of the spirit of the old priest who when asked how he found it possible to live so long patiently working among a community from whom he succeeded in claiming very few converts, replied simply: "Cest mon metier".

There should surely be found also the spirit of *Joy* with no underlying hint that "poverty has anything noble about it." May it not be that in his advocacy of the *charka* and its meagre addition to the miserable income of the spinner the Mahatma has forgotten beauty and has forgotten joy? Has he not also forgotten the true economy, the economy of divine abundance which is moneyless?

There is no sense of squalid poverty or grinding toil in the case of the Scotch crofter, spinning and weaving the wool of his own sheep into "Scotch tweed" sought after by the wealthy as material of enduring quality, dyed moreover in colours extracted from the vegetation of the Scottish countryside.

Not only has poverty "nothing noble about it", it is actually a disease, the product of ignorance and false philosophy. The ordinary cheerful interests which should accompany normal day-to-day living are in the Indian village crowded into "fights and festivals", law suits and weddings, and the money which should circulate freely drains off into the pocket of the moneylender and the accumulating debt saps the energy and initiative of the coming creative worker. Perhaps the restrictions on expenditure on wedding and such like entertainment with which war-time and famine conditions have made us sadly familiar will make possible the introduction of the custom which prevails, according to Kagawa, in Japan, when each wedding guest brings a contribution of food to the value of four annas and so, as Kagawa says, the bride and bridegroom are not tramelled all their life with debt.

Without something of the joy of the artist and the craftsman there can be no true incentive to labour.

The common remark heard chiefly in "financial" circles that men will always require "the carrot and the stick" is fundamentally untrue and is the product largely of ignorant and wishful thinking.

No one can hold such a view who has seen the pride with which a worker in the harness and saddlery factory at Cawnpore will hold up for the visitor's inspection the small saddle-piece which he has just forged, and of which he makes scores every day. Repetitive work yes—but craftsmanship.

Even more when two simple coolies prostrate themselves in gratitude before the Lancashire fitter as he is about to enter his train on his departure for England, because during the erection of some chemical plant he has taught them to cut a screw, to fit piping and to set a line shaft truly, because he has taught them to be craftsmen and so has increased their self-respect and *earning* power. There is here no danger of creating a slave mentality as one visitor to Wardha feared on seeing the children driven to work for the miserable sums needed to pay for their "education".

The "carrot and the stick" mentality is based on a wrong concept of money and its uses. When money is used to "breed" money, instead of irrigating crops and feeding the farmer, then trouble is in the making. There are conditions in India at the present time which have not a few analogies to the conditions in England in the days of William Cobbett, "the rider of the shires", and out of which emerged the Reform Bill of 1832. There is the same crowding into the town to increased wages, the same absentee landownership and even the increasing dependence for food supply from overseas paid for ultimately by vast areas of erosion. That there should be voices raised from more than one side against "industrialisation" is not surprising.

We are told in the course of this section that the greatest problem of village development is the increase of purchasing power. Sir Daniel Hamilton has shown us at Gosaba that money is only a token certificate, equivalent to so much useful labour, to be exchanged for food and shelter and clothing and not a seed for raising a crop of permanent debt. Money itself costs only the making and printing of the paper tickets or notes, each one of which may circulate as many as fourteen times while paying for Rs. 14 worth of useful labour. Provided there is energy and goodwill there need be no resort to the family jewels or to the moneylender with his all-devouring *interest* and its ever-spreading jungle growth of debt. The energy and goodwill which are the true wealth or "money" of the community are born of that change of consciousness, that more abundant Life to which reference has been made.

At one centre to which a special chapter is devoted, *viz.*, Marthandam in Travancore, something of this spirit seems to have been awakened and we read of a Collective Centre, a Honey Club, a Weavers' Club and many other activities as well as exhibitions and lectures not forgetting village games, dancing and folk-singing.

Cottage industries in themselves will not save India from the "cry of the children" and the bitter memories of the "Industrial Revolution". The test held up by George Meredith in another connection applies here: "Is it expressive in song?" True labour is always joyous, the joy of the artist, the joy of the craftsman. For the money-slave there is no joy, only weariness and smouldering bitterness.

All this is well recognised by the writers of the articles under review.

Once this spirit of pride and joy in productive and creative activity is awakened all the developments foreshadowed in the present volume and the other publications referred to become possible, modified though they may have to be by climatic, and sometimes by other reasons, difficult to foresee.

To one local philosopher who had experienced a Cawnpore hot weather there seemed nothing for it but to "alter the path of the sun". His conclusion would seem to be confirmed by the world map on page 125 of Melchett's *Modern Money*, picturing the effect of climate on industrial energy. More than half

of India is shown as "very low". Anyone who has endured the "hot weather" in these regions will sympathise with the Indian worker, remembering how when the stress of heat "let up" the lethargic brain seemed suddenly to become active as if the engine had started again and all the machinery of the factory was humming once more into operation.

Nevertheless we hear from at least one responsible employer of world experience that in an "air-conditioned factory" Indian labour is as efficient as any other.

If as in China electric light can be provided for the smallest village hut why not fans and ultimately large-scale air-conditioning, and so the climatic handicap be overcome. We are already reading of the production of "artificial snow" by rocketting dry ice into potential rain clouds. The effect of "atomic" explosions on climate has yet to be studied.

In addition to climatic difficulties the earnest worker may have to contend with his own inexperience which may sometimes provoke the remark of the countryman quoted by Massingham in his book *The Wisdom of the Fields*: "I likes eddicated people but the worst of it is they be so dommed ignorant."

There is always this danger in introducing what would seem to be manifest improvements. The present reviewer, when he controlled his own garden, purchased a pump to facilitate lifting water for a moderate sized garden, only to find that the muscles of the *mali's* arms were unaccustomed to the movement and effort required so that he had rigged up a bucket and a pulley as being more convenient and equally efficient.

We also read of rubber-tyred bullock-carts moving comfortably and economically on tarmac. Actually it has been pointed out that in discarding the high old-fashioned narrow-tyred wheel of the *bullock-bundy* we are adding to the burden of the bullock by depriving him of the power equivalent to that residing in the driving wheel of a locomotive. The tarmac too is slippery and hard on his feet. It is not so easy to move the rubber-tyred cart over the uneven village or estate roads or tracks.

Under the Section *Health and Sanitation*, in addition to the general subject of village cleanliness are included descriptions of model houses as well as of the latest scientific methods for dealing with village wastes. Besides human and animal excreta these include ordinary rubbish and garbage to be dealt with by the method of *composting* practised for ages in China but only recently adopted on the large scale in India.

The problem of the clean village is again largely psychological. It is not only the villager who appears to be devoid of a civic conscience. Are not many of us aware of "filthy Calcutta" and of the Marina in Madras? In his own efforts after more efficient nitrogen conservation, which involves civic sanitation and increased food production, the reviewer has cordially to acknowledge the personal support he has received from Mahatma Gandhi.

Although there is reason to believe that a difference in standards of civic and communal cleanliness has not a little to do with racial troubles in South Africa, yet in fairness it must be remembered that this difference is by no means one of racial or national idiosyncracy. Many years ago the late Dr. Calmette endeavoured to awaken the people of France to the same sense of civic cleanliness that he had found in England. Nevertheless modern methods of sewage disposal were adopted in the U.S.A. sooner than in England, the country of their discovery. Sewage and refuse disposal moreover is not the only criterion of civic cleanliness. "Smoke abatement" is in some respects more needed than river pollution prevention since it is possible to keep away from an unsavoury river whereas a smoke-laden atmosphere cannot be escaped from, and has indeed far-reaching effects, even in some cases impairing the pristine purity of the city water-supply in the distant mountain reservoir.

Nevertheless amidst the smoke and grime of the "Manchester particular", when the electric lights have to be on in the office all day and the papers brought away to India still reek of sulphur and chlorine, there is to be found the mentality which declares, "If dirt means money give me dirt". Do not let us be too hard on the Indian villager.

Though his methods of sanitary waste disposal may now be mainly those of the domestic pussy cat and the wandering Israelite, and which it may be remarked are in some respects entirely scientific, good accounts are given in this section of the most up-to-date and scientific methods which can be applied to Indian village conditions. Thus cowdung is utilised both as fuel and fertiliser throug its anaerobic fermentation with production of methane, while household needs are met by the provision of the carefully designed aqua privy. (The description of methane production has evidently caused the printer some trouble since there is a confusion between the single word "anaerobic" meaning fermentation in *absence* of air, and the two words "an aerobic" change, which means in *presence* of air!)

There is much to be said for the utilization of cowdung in the manner described since in addition to the methane which can be used both for fuel and lighting, the effluent from the tank will contain most of the nitrogen of the cowdung, and, possibly with some dilution, can be used for the irrigation of crops. The little intensive nitrifying filter attached to the aqua privy suggests the possibility of nitre recovery on the lines proposed by the reviewer during a symposium at the National Institute of Sciences of India.*

While the methane production tank and the aqua privy may rank as the most "civilised" of the methods described, and both have much to recommend them, they rather assume that some modest sanitary engineering assistance will be available. Just as the Bhore Commit-

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* Note on the Production of Nitre (Potassium Nitrate) from Ammoniacal Waste"—Contribution by G. J. Fowler to symposium held in Delhi on 20th Nov. **1945.** Republished in *J. and Proc. Institution of Chemists (India)*, Dec. **1945.**

tee have recommended one doctor for every 2,000 of the population, so in addition to a village maistry it may be hoped that a sanitary inspector with adequate knowledge of sanitary engineering may be available at least for a group of villages of resonable extent.

The last section on *Education* and *Culture* lifts the mind into regions of high romance. Instead of ignorance, poverty and squalor, we are led to think rather of the hidden springs of the people's life, expressed in forms of artistic decorative design, of old-time song, music and dance, having their origin in age-old regions of consciousness. May this volume play its part in bringing about the true renaissance which its pages bring so vividly before us.

GILBERT J. FOWLER.

"Seasonal Breeding and Migrations of the Desert Locust (*Schistocerca gregaria* Forskal) in Eastern Africa," by Z. Waloff. *Anti-Locust Memoir*, 1, 1946. Pp. 74, quarto.

The Anti-Locust Research Centre of the British Museum (Natural History) in London, has, since its inception in 1929, been systematically collecting records of reports of breeding and migrations of locusts in Africa and Western and Southern Asia (including India). From 1933 to 1938 the Centre issued comprehensive annual reports of locust breeding and movements. With the beginning of the war this ceased, but other research papers continued to be published from time to time. Now the Centre has launched upon two new ventures to be published from time to time—the *Anti-Locust Memoirs* and the *Anti-Locust Bulletins*. The first number of the *Memoirs*, by Waloff, has just been received, and deals with the Desert Locust in Eastern Africa.

After briefly describing the physical features and climate of Eastern Africa, Waloff goes on to a detailed and amply illustrated account of the main patterns of breeding and migrations of the desert locust from month to month. The history of various swarms is carefully traced, and the result is the accumulation of a vast mass of accurate information on movements. Finally, an attempt is made, on the whole successfully, of correlating the movements and breeding of swarms to meteorological conditions, particularly temperature and rainfall. It is concluded that, generally speaking, swarms migrate down-wind—as already shown long ago by Rao for India and by Predtechenskii (to whom Waloff makes no reference) for Persia and some adjacent countries—although older swarms tend sometimes to fly against the prevailing winds. Low temperatures slow down the movements of swarms, but cessation occurs only below 22° C. It is to be regretted that Waloff did not pay detailed attention to atmospheric pressures, since it is probable that the actual direction of migration from one area to another—as, for example, from a very hot and arid area to a more congenial one—may be conditioned by pressure gradients. It is known that low atmospheric pressures throw some insects into a state of restlessness. Many years ago, I witnessed this phenomenon in the Punjab among the desert locusts kept in a large field-cage. One evening, a few minutes before the arrival of a dust storm in the summer months when pressures drop considerably, all the locusts were noticed to fly, jump about and flutter their wings excitedly, although hitherto they were perfectly normal. With the passing of the storm and the restoration of normal pressure, the locusts regained their normal composure. It seemed that had the locusts been free, they would have gone with the wind, the drop in atmospheric pressure serving as the stimulus for the initiation of migration. But possibly the relevant data on pressures were not available to Waloff.

The desert locust appears to have no fixed annual breeding cycle in Eastern Africa (in contrast to India), and the incidence of breeding depends, among other factors, on the incidence of suitable rainfall. There is, nevertheless, a fairly regular pattern of seasonal distributions over Eastern Africa, the pattern changing from season to season in a regular manner, the change, according to Waloff, being due to physiological responses of the locust to climatic factors, and not to migration and breeding cycles characteristic of the species.

The desert locust being the most common locust in India, Waloff's *Memoir* is of special interest to us. We have in India an opposite number of the Anti-Locust Research Centre, called the Locust Warning Organization, functioning since 1939. During the eight years of its existence, it must have accumulated a vast mass of field data on locust movements, meteorological conditions and so on. These data if suitably analysed and published would be of great interest to all students of locust biology. In the absence of suitable analysis, prompt publication of even the unanalysed data from year to year would serve a very useful purpose. It may be hoped that the Organization will consider doing so, preferably on the lines of the *Anti-Locust Memoirs* or *Bulletins*.

M. L. ROONWAL.

Food and Diet in the Mouryan Empire. By "Krishivala". (Madras Chamber of Agriculture, Madras), 1946. Price Annas 6.

The author quotes from the *Arthasastra* of Kautilya to prove his point that agriculture, animal husbandry, storage and marketing of produce and the nutrition of the people were looked after efficiently by the State more than two thousand years ago. The extracts throw light, if any was needed, on the civilized state of the Indian Society in ancient times. The booklet is readable. There are a few typographical errors, however, which could have been easily avoided.

V. N. P.

SCIENCE NOTES AND NEWS

ON THE PROOF OF THE INVERSE SQUARE LAW AND THE MEASUREMENT OF H

In a communication, Mr. V. R. Singal, Professor of Physics, Gordon College, Rawalpindi, has drawn attention to the common errors in the experimental verification ($\tan\theta_A/\tan\theta_B = 2$) of the Gauss inverse square law using a deflection magnetometer. He suggests an alternative method of verifying the law. It may be shown that $\tan^2\theta_A \tan^{3/2}/\phi_B = 2$, where ϕ_A is the angle between the x-axis and the linear graph between $(d/\tan\theta_A)^{1/2}$ and d^2 for the A position and ϕ_B is the angle between the x-axis and the linear graph between $\tan^{-2/3}\theta_B$ and d^2 for the B position. Experimental tests show that this relation gives values close to 2. Also M/H may be calculated from the relation $\frac{1}{2}\tan^2\phi_A = \tan^{-3/2}\phi_B = M/H$. The moment M of the magnet and the horizontal intensity H of the earth's magnetic field may be determined if MH is found by the oscillation method.

UNIVERSITY OF MADRAS: "THE MAHARAJA OF TRAVANCORE-CURZON PRIZES" FOR 1947-48

Two prizes, one in each of the following groups of subjects, will be awarded by the Syndicate for the best essay or thesis *written by any Graduate of the Madras University* on any topic dealing with one of the subjects mentioned in the following two groups:—

(A) Chemistry, Biochemistry, Agricultural Chemistry. (B) Botany, Zoology, Physiology.

The value of each prize is Rs. 250.

The essay or thesis must be the result of the personal investigations of the author, and must contain clear evidence of independent and original research. Essays or theses which consist only of criticisms, compilations or the history of a subject, unaccompanied by the results of personal, independent, original research will be ineligible for the prize.

The work submitted should not have formed the basis of a work for which any prize or a degree had been previously awarded.

The prize will *not* be awarded to the same applicant on a second occasion.

Competitors must submit their theses so as to be received by the Registrar not later than 1st *March* 1948.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The Government of India have decided to continue the existing constitution for the Council of Scientific and Industrial Research, in view of the unanimous opinion of the members representing Industry and Science on that body. They have also decided to abolish from April 1, 1947, the Industrial Research Utilisation Committee which was an Advisory Body to assist the Council.

The following have been nominated to the Governing Body of the Council for a period of three years from April 1, 1947: (1) The Hon'ble Member in charge of Industries and Supplies (*President*); (2) Sir S. S. Bhatnagar, Director, Scientific and Industrial Research; (3) Sir Arthur Waugh, Secretary to the Department of Industries and Supplies; (4) Mr. A. K. Chanda, Financial Adviser; (5) Sir J. C. Ghosh, Bangalore; (6) Prof. M. N. Saha, Calcutta; (7) Sir Shri Ram, New Delhi; (8) Sir A. Dalal, Bombay; (9) Mr. J. R. D. Tata, Bombay; (10) Sir Ghulam Mohammad, Bombay; (11) Dr. Nazir Ahmad, Indian Tariff Board, Bombay; (12) Mr. Kasturbhai Lalbhai, Ahmedabad; (13) Mr. A. F. Hirtzal, M.L.A. (Central); (14) Sir A. L. Mudaliar, Madras; (15) Mr. H. Sitaram Reddy, Minister for Industries, Madras; (16) Mr. G. D. Birla, New Delhi; (17) Mr. N. V. Gadgil, M.L.A. (Central), (18) Dr. K. A. Hamied, Bombay; and (19) Sir Mohammad Yamin Khan, M.L.A. (Central).

BOARD OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The following have been nominated to the Board of Scientific and Industrial Research for a period of three years from April 1, 1947: (1) The President, CSIR; (2) Sir S. S. Bhatnagar; (3) Dr. B. C. Roy, Calcutta; (4) Dr. N. N. Law, Calcutta; (5) Mr. P. F. S. Warren, Calcutta; (6) Dr. Jivaraj N. Mehta, Bombay; (7) Dr. Nazir Ahmad; (8) Sir Rahimtoola Chinoy, Bombay; (9) Sir J. C. Ghosh; (10) Dr. M. Qureshi, Hyderabad (Dn.); (11) Sir K. S. Krishnan, Allahabad; (12) Mr. Kasturbhai Lalbhai; (13) Prof. M. N. Saha; (14) Sir Shri Ram; (15) Sir Arthur Waugh; (16) Sir A. Dalal; (17) Sir Ghulam Mohammad; (18) Scientific Adviser to the G.H.Q., New Delhi; (19) Sir Teja Singh Malik, Member, F.P.S.C.; (20) Sir C. V. Raman, Bangalore; (21) Dr. H. J. Bhabha, Bombay; and (22) Mr. D. N. Wadia, Mineral Adviser, W.M. & P. Department.

AN INTERNATIONAL CONGRESS ON THE EXPLOITATION AND UTILISATION OF WOOD

An International Congress on the exploitation and utilisation of wood was held in Paris from September 16th to 30th, 1946, according to *For. Abstracts*, under the auspices of the Services de la Production Forestiere. Special attention was given to the exploitation of coppice for firewood. France at present produces only one-quarter of her pulpwood needs, but has a large surplus of small firewood which could be used for the manufacture of cardboard, etc. The utilisation of firewood for charcoal manufacture and modern methods of heating was also considered.

17TH INTERNATIONAL PHYSIOLOGICAL CONGRESS

The 17th International Physiological Congress will be held in Oxford, England, July 22-25, 1947, under the presidency of Sir Henry Dale. A tentative programme may be obtained from the Secretary, E. W. Geidt, University Laboratory of Physiology, Oxford. Physiologists in London plan to entertain members of the Congress from abroad, for a few days, immediately after the Oxford meeting. It is hoped that accommodation can be arranged for those visiting members who wish to take advantage of this invitation to visit Physiological Laboratories and Medical Institutes in London. It is hoped also that it may be possible to arrange for small parties of members to visit laboratories in certain other towns during the week following the Congress.

THE INTERNATIONAL UNION OF CHEMISTRY

The International Union of Chemistry is being revived within a broader framework, and meetings of the world-wide scientific organisation will be resumed with a world chemical congress and conference in London, July 1947. M. T. Bogert of Columbia University will be president. During meetings recently held at London, a temporary bureau has been set up (R. Delaby, Paris, Gen. Secy.), which will prepare the congress and conduct the affairs of the Union for the time being. Many of the commissions of the Union have been active in spite of the war. At present these are as follows:—(1) Analytical reagents and reactions, (2) Atoms, (3) Atomic weights (Annual Tables), (4) Fats, (5) Finances, (6) Nomenclature, Inorganic, (7) Nomenclature, Organic, (8) Nomenclature, Biologic, (9) Physical constants, (10) Physical chemistry data, (11) Physical chemistry standards, (12) Physical chemistry symbols, (13) Radio-active constants, (14) Thermochemistry, (15) Weston Pile. The creation of three additional commissions is now under study, *viz.*, (16) Macromolecular compounds, (17) Determination of small quantities of toxic substances in industrial atmospheres, and (18) Normalisation of laboratory materials.

THE 13TH INTERNATIONAL CONGRESS OF ZOOLOGY

The 13th International Congress of Zoology will be held in Paris during 1948. E. Fisher-Piette, the General Secretary, Lab. de Malacologie, 55, Rue de Buffon, Paris V, urgently asks the directors of all zoological institutions to send him a complete list of the members of their staff in order that he will be able to inform all colleagues well about the Congress.

INDIAN INSTITUTE OF METALS

An Indian Institute of Metals has been formed with a view to developing metallurgical research and to promote the study of metallurgy in India. This is the first Metallurgical Institute of its kind in India and will be organised and run on lines of the British and American Metallurgical Institutes. Sir J. J. Gandhi, Director, Tata Iron and Steel Company, has been elected President of the Governing Council, and Dr. D. P. Antia, Metals Department Officer, Director-General of Industries and Supplies, Government of India, has been elected Honorary Secretary.

A NEW COMET

The discovery of a new Comet was announced on the 1st of April by Dr. J. S. Paraskevopoulos, Director of the Borden Station of the Harvard Observatory at Bloemfontein in South Africa.

The Comet was first spotted on March 24th in the Constellation of Centaurus moving southwards across the line between the star Alpha, Centaurus and Southern Cross. Two days later it was recorded at the Cardova Observatory in Argentina. It is at present in the Constellation of Chameleon.

ATOMIC RESEARCH

It is learnt that Sir S. S. Bhatnagar, Director of the Council of Scientific and Industrial Research, and Dr. H. J. Bhabha, Director of the Tata Institute of Fundamental Research, have been deputed by the Government of India to investigate the possibility of developing atomic energy from the monazite sands of Travancore.

NATIONAL PHYSICAL LABORATORY

It has been announced that Sir K. S. Krishnan has been appointed Director of the National Physical Laboratory at New Delhi.

NATIONAL CHEMICAL LABORATORY

We understand that Prof. S. Siddique has been appointed Director of the National Chemical Laboratory, the foundation of which was laid at Poona by the Hon'ble B. G. Kher on the 6th of April.

HOWARD MEDAL—1946

Mr. A. C. Dey, of Chemistry and Minor Forest Products Branch, Dehra Dun, has been awarded the *Howard Medal* for 1946 at the annual Convocation of the Forest Research Institute and Colleges, presided over by the Hon'ble Dr. Rajendra Prasad, Member for Agriculture and Food, Government of India, in recognition of his contribution to the advancement of research at the Forest Research Institute. This award specifically relates to Mr. Dey's meritorious research work on *Ocimum*.

ERRATA

Vol. 16, No. 1, p. 34, line 4—Review of the book *An Introduction to Textile Bleaching*: The price of the book is 32*sh*. net and *not* 23/- as printed. Line 13: *for* 'what' please *read* 'which'.

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RICE RESEARCH

THE plenary session of the Rice Study Group, constituted under the auspices of the United Nations Food and Agricultural Organisation, was inaugurated by Dr. Rajendra Prasad at Trivandrum on the 16th of this month. This Group is the forerunner of the full Rice Conference to be held later this year. The function of the Group is reported to be limited to reviewing the rice problems of the countries in South-East Asia and recommending steps to secure increased produciton and arrange for timely and proper distribution of rice to the countries in need. The Group's report will be submitted to the next annual conference of the UNFAO.

Dr. Rajendra Prasad rightly stressed in his opening address the necessity for increasing the production of the commodity, and appealed to one and all to put forth the best effort in this direction. It appears to us, however, that if the Group confines itself merely to the problems of production and distribution the scope and utility of the Rice Conference will be unwarrantedly limited. For among the rice-producing countries—India, China, Japan, Siam, Burma, Indonesia—there are as many countries that have an exportable surplus as those that suffer from a shortage. And the bottle-neck of transport which has upset the rice economy of all these countries can only be temporary. But this is not to belittle the gravity of the situation with regard to rice shortage. We have suffered bitterly during the war, and still continue to suffer for our neglect in the matter of self-sufficiency of this staple article of diet in South India and Bengal. And if a similar calamity is to be averted we can lose no time in making up the deficit.

The deficit in India is of the order of about 2 million tons a year which must be made up, not by depending on imports, but both by intensive and extensive cultivation. The average yield of this crop in India is perhaps the lowest in the world, with twice the yield in China, three times in Japan and five times in Italy. More alarming still is the steady fall in the average as well as the total yield of rice which, when juxtaposed with a growing population, cannot but lead to acute shortage. An average yield in 1934 of 28·5 bushels per acre has diminished to 26·2 in 1939, and to 22·7 in 1941. Among the obvious causes for such a fall are the wasteful exhaustion of the soil and the primitive technique of agriculture, both of which brook no delay in being remedied. The indigenous manufacture of artificial manures and agricultural implements, and the systematic exploitation of town wastes for manure in the form of compost and purified sewage must go a long way in solving the critical problem of manure shortage.

What we should, however, like to emphasise is the indispensable need for long-term basic research on Rice. Unfortunately rice has received very little attention at the hands of the scientists compared to wheat, the staple food of the West. Wheat has been studied not merely from the agricultural but also from the genetical, biochemical and nutritional points of view. Thus a number of useful mutants like short-term and winter wheat, pest and rust-resisting wheat, whole meal and enriched flours have been evolved; and the wheat plant itself has formed the subject of extensive studies on plant nutrition and plant pathology. But with regard to rice, except for some work in Japan, investigations on rice and rice plant still remain to be studied. The paucity of knowledge in this field is reflected, in a way, in the scarcity of books and monographs on the subject.

Of the 2,000 and odd varieties of rice more than 700 are grown commercially in India. These differ, as is well known, not only in colour, flavour, shape and taste, but in their average yields per acre, cooking quality and digestibility. What is perhaps less known is that their chemical composition, vitamin content and nutritive value are also different. Some types, like the hill rice, thrive only on rain water, while others require a continuous supply up to a stage of development. A few are short-term crops while the rest are mostly long-term. The resistance to disease and pests also differs with the species. These characteristics are naturally genetical, and have to be studied from that angle, if we are to ultimately evolve mutants "to order". And the rice plant nutrition itself forms a wide and fertile field for research.

An important aspect of applied rice research which is yet to receive due attention is the utilisation and commercial exploitation of the by-products of the rice industry. The straw, which is not normally fed to milch cattle, could be processed with weak alkali or otherwise in order to render it innocuous and useful for milking animals. The husk, apart from its low fuel value, could be more usefully exploited for the production of activated charcoals, furfural and other products. The rice-bran provides a rich source for processing vitamin concentrates of the B group. Successful exploitation of these by-products will not only lead to the establishment of a prosperous chemurgical industry but also help to subsidise the farmer and reduce the cost of rice for the consumer.

We hope the Rice Research Institute, which is now being organised at Cuttack by the Government of India, will be conceived on a scale comprehensive enough to include both the fundamental and applied aspects of the rice problem. In view of the importance of the subject to more than 150 million people in the country, and the wide variety and urgency of the problems, it is worth contemplating the establishment of a number of regional experimental stations in rice-growing areas. For the South, Coimbatore, where pioneering work has been carried out in this branch as in sugarcane, offers excellent possibilities for starting one of these research stations. With experimental stations dotted over the wide rice-producing areas, intensive research could be carried out on a scale liberal enough to yield quick and practical results which will help in averting crises similar to those we are facing to-day. We trust the Government and the rice-producing interests will sufficiently realise the importance of long-term basic research in solving the manifold problems of rice research.

EDITORIAL NOTES

SCIENTIFIC MAN-POWER COMMITTEE

THE institution of the Committee on Scientific Man-Power by the Government of India is a necessary corollary of the post-war plans of intensive industrialisation of the country and the training of the scientific personnel in India and abroad. The Committee is entrusted with the task, not only of assessing the long-range requirements for scientific and technical man-power but of utilising to best advantage the available skill in the country. In the last issue we discussed at length the former aspect of the question. The latter part is of immediate, and perhaps of crucial importance, and involves careful stock-taking of scientific talent scattered in various walks of life.

It is well known that a large number of bright science students have had to enter, till very recently, professions on which the specialised training they had received at the universities are thrown away. Only a small fraction indeed of the science graduates are still following a connected profession either in tutorial or technical capacity. If, therefore, all the trained men could be salvaged we might not really be so hard up for scientific man-power as it might at first appear. It might perhaps be argued that all the men, now languishing in non-scientific professions, cannot be mobilised for the purpose inasmuch as they have lost contact with science for varyingly long periods. But even those who have lately left the universities since the commencement of the war and who have entered the combatant and non-combatant

ranks in the army or various civilian jobs should make up a respectable number running into a few thousands. These men, young and fresh enough to benefit by refresher courses and special training, will surely come in handy to mann the industries and laboratories that are to come into action in the shortest possible period.

In utilising the available man-power it would be of mutual advantage, to scientist and technician as well as to employer (private or Government), if a Scientific Man-Power Exchange be established by Government and all technical jobs are filled in through this agency. For it is unlikely that a mere maintenance of a register of scientific and technical personnel, as laid down in the terms of reference to the Committee, will be of much benefit to either party. We expect the Scientific Man-Power Committee will go into these questions in detail in formulating their recommendations for the development and exploitation of scientific man-power in India.

PASTURALOGY

PASTURALOGY concerns itself with the various aspects of pasture propagation and maintenance. The publications of the British Grassland Society is an urgent reminder of the necessity and importance of developing this branch of agricultural science in India, and its proceedings bring into relief the gross neglect of the technique of Pasture-growing in this country.

In Great Britain, America, Sweden and Denmark, intensive research is being carried on from the point of view of raising the grass yield, immunising it against pests either by breeding resistant strains or by chemical treatment, finding the types suitable for various soils and climates, increasing its nutritive value and numerous other economic and scientific possibilities. In India, on the other hand, except for a few ostentatious trials with Napier grass or Guinea grass or California grass little attention has been paid to the subject.

Unlike in other lands the Indian farmer does not believe in allotting lands exclusively for growing pasture or other cattle fodder. The straw that remains over after collecting the food-crops is the only standby for his cattle for a good part of the year. It is not surprising, therefore, that Indian cattle are notoriously poor yielders. And this is due in no small part to the total neglect of pasturalogy.

In this country for each big village or a number of small ones a patch of land is allotted as common pasture for cattle. There is no ploughing nor sowing nor weeding of this land. The little grass that grows after the rains is soon grazed even as it grows, and for the major part of the year there is no pasture at all. The animals are given no change of grassland from one end of the year to the other, nor is there a rotation of crop in this common patch.

Thus the cumulative effect of such a policy has been that about 400,000 acres of land allotted for cattle in villages are being run to waste at a time when we can ill-afford to spare a single acre of cultivable land. With the gross paucity of dairy products facing the growing population it is needless to emphasise that all this land, and if necessary more, should be exploited in a way that would yield the highest economic returns.

Had we paid sufficient attention to pasturalogy we should not have been now driven to the desperate necessity of seeking inferior substitutes for milk and milk products in the form of vegetable milks and vegetable fats. Elsewhere it has been shown, for instance, that the weight promotion and milk yield is about 30 per cent. less per acre of permanent pasture than with pasture wherein rotation of crops is practised. It is also known that certain types of soils are fitted for the growth of only certain types of grasses. Evaluation of the economic worth of various types of grasses and pastures by way of the grazing animal is now being increasingly recognised as a rational method. These findings of pasture research indicate the concrete benefits we could derive by putting them into practice and working out for ourselves methods of cultivation and utilisation of grasslands suited to our climes.

If we are, therefore, in earnest about increasing the yield of milk and milk products and raising the level of consumption we cannot pay too much attention to this aspect of the dairy industry. While the Indian Council of Agricultural Research could actively sponsor intensive research into pasturalogy, the State must always be on the alert to translate the outcome of such research by proper publicity, education through rural exhibitions and demonstrations, and if necessary, by subsidisation and legislation.

ALL-INDIA COUNCIL FOR TECHNICAL EDUCATION

THE Mysore Government have invited the All-India Council for Technical Education to hold their next meeting in Bangalore. This invitation has been accepted and the Chairman of the Council, Mr. N. R. Sarkar, has fixed May 29 and 30, 1947, for the meeting.

The Council will consider, among other matters,

(i) a preliminary report on survey of technical institutions in the country;

(ii) reports of the Visiting Committees appointed by the Co-ordinating Committee of the Council to visit some of the important technical institutions in the country and to make recommendations for their improvement;

(iii) the question of formation of the Regional Committees of the All-India Council for Technical Education; and

(iv) the location of the proposed Higher Technical Institutions for the North and the South.

ON FRACTIONAL REPLICATION OF THE GENERAL SYMMETRICAL FACTORIAL DESIGN

BY K. KISHEN

(*Statistician, Department of Agriculture, U.P., Lucknow*)

FACTORIAL designs have now come to be extensively used for testing in a single experiment the effect of a number of interacting sets of factors. When, however, the number of sets of factors and/or the number of levels of each set of factors is large, there result a great number of treatment combinations. In such cases, even a single replication necessitates the use of large quantities of experimental material, the availability of which may be beyond the resources of the experimenter. It, therefore, becomes necessary to resort to the device of fractional replication which enables a factorial experiment to be carried out with only a fraction of the experimental units required for a complete replication. The basic principles of this theory have been developed in a recent paper by Finney,[1] who has, however, restricted himself to factorial arrangements p^n, where p is a prime number. It is the purpose of this note to show that, with the help of the geometrical theory of confounding given earlier by Bose and Kishen,[2] Finney's theory can be easily extended to the general symmetrical factorial arrangement s^m, where $s = p^n$, p being a prime positive integer and n any positive integer.

Bose and Kishen[2] have, by representing a treatment combination in an s^m factorial arrangement by a finite point of the associated m-dimensional projective geometry PG (m, s) constructed from the Galois field GF(s), established a (1, 1) correspondence between the s^m treatment combinations and the s^m points of the Euclidean geometry EG(m, s), which is a portion of PG(m, s). It has been demonstrated by Carmichael that the elements of the Abelian group of order s^m and type $(1, 1, \ldots\ldots\ldots, 1)$ afford concrete representations of the EG(m, s). Thus, the correspondence of the s^m factorial design to the Abelian group of order s^m and type $(1, 1, \ldots\ldots., 1)$ follows.

The treatment combinations in an s^m factorial arrangement may be represented by symbols $a_1^{\beta_1} a_2^{\beta_2} \ldots a_m^{\beta_m}$, where $\beta_1, \beta_2 \ldots, \beta_m$ take only the values $0, 1, 2, \ldots s-1$. If now $0, 1, 2, \ldots, s-1$ are taken to denote the s elements $\alpha_0 = 0, \alpha_1, \alpha_2, \ldots \alpha_{s-1}$ respectively of GF (s), it would appear that these symbols form an Abelian group of order s^m and type $(1, 1 \ldots, 1)$. It may be remarked here that there are different ways of identifying $\alpha_1, \alpha_2, \ldots \alpha_{s-1}$ with the $s-1$ non-zero elements of GF(s) when expressed in the standard form. In the case $n = 1$, *i.e.* when s is a prime number p, the identification we adopt is to take α_i equal to the residue class (i), modulo p. In the case when $n > 1$, *i.e.* when s is a power of a prime higher than the first, we take α_i equal to the residue class modulo $f(x)$ of the polynomial x^{i-1}, where $f(x)$ is a specified minimum function and the class with standard representative x is a primitive element of GF(s). The Abelian group of main effects and interactions, which is isomorphic to the group of treatment combinations, is then represented by the symbols $A_1^{\beta_1'} A_2^{\beta_2'} \ldots A_m^{\beta_m'}$, where $\beta_1', \beta_2', \ldots \beta_m'$ take only the values $0, 1, 2, \ldots \ldots, s-1$, these being the s elements of GF(s). Two elements $a_1^{\beta_1} a_2^{\beta_2} \ldots a_m^{\beta_m}$ and $a_1^{\beta_1'} a_2^{\beta_2'} \ldots a_m^{\beta_m'}$ of the treatment group will be defined to be orthogonal if $\Sigma \beta_i \beta_i' = 0$ in GF(s). Similarly, two elements $a_1^{\beta_1} a_2^{\beta_2} \ldots a_m^{\beta_m}$ and $A_1^{\beta_1'} A_2^{\beta_2'} \ldots A_m^{\beta_m'}$, the first of the treatment group and the second of the effect group, will be termed orthogonal if $\Sigma \beta_i \beta_i' = 0$ in GF(s). It would appear that if a treatment subgroup of order s^{m-k} is selected, the complete orthogonal effect subgroup is of order s^k.

The correspondence between effect subgroups and parallel pencils of $(m-1)$-flats representing main effects and interactions follows readily from Bose and Kishen's theory. Thus, the pencil $x_{i_1} = \alpha_j$ $(j = 0, 1, \ldots s-1)$ of s parallel finite $(m-1)$-flats representing the $s-1$ degrees of freedom for the main effect A_{i_1} corresponds to the effect subgroup $I, A_{i_1}, A_{i_1}^2, \ldots \ldots A_{i_1}^{(s-1)}$ of order s, and the complete orthogonal treatment subgroup of order s^{m-1} is given by the s^{m-1} treatment combinations corresponding to the s^{m-1} finite points lying on $x_{i_1} = 0$.

In general, the $s-1$ degrees of freedom for the k-factor interaction among the i_1-th, i_2-th, $\ldots$ and i_k-th factors represented by the pencil

$$x_{i_1} + \alpha_{j_2} x_{i_2} + \alpha_{j_3} x_{i_3} + \ldots + \alpha_{j_k} x_{i_k} = \alpha_r \ (j_2, j_3, \ldots j_k \text{ fixed};\ r = 0, 1, \ldots s-1)$$

correspond to the effect subgroup of order s given by

$$I, A_{i_1} A_{i_2}^{j_2} A_{i_3}^{j_3} \ldots A_{i_k}^{j_k}, A_{i_1}^2, A_{i_2}^{2j_2} \ldots A_{i_k}^{2j_k}, \ldots, A_{i_1}^{(s-1)} A_{i_2}^{(s-1)j_2} \ldots A_{i_k}^{(s-1)j_k},$$

where tj_p $(t = 1, \ldots s-1;\ p = 2, \ldots, k)$ stands for the product of these two numbers in GF (s). The complete orthogonal treatment subgroup of order s^{m-1} is given by the treatment combinations corresponding to the s^{m-1} finite points lying on the $(m-1)$-flat $x_{i_1} + \alpha_{j_2} x_{i_2} + \ldots \ldots + \alpha_{j_k} x_{i_k} = 0$. Giving to $j_2, \ldots j_k$ the values $1, 2, \ldots, s-1$, we obtain all the $(s-1)^{k-1}$ pencils corresponding to the k-factor interaction. There are, therefore, $(s-1)^{k-1}$ effect subgroups of order s containing only the symbols $A_{i_1}, A_{i_2}, \ldots, A_{i_k}$, but no others, which correspond to the $(s-1)^k$ degrees of freedom for the interaction $A_{i_1} A_{i_2} \ldots A_{i_k}$.

It would appear from the above that each $(m-2)$-flat in the $(m-1)$-flat at infinity is the vertex of a parallel pencil of s $(m-1)$-flats, which corresponds to an effect subgroup of order s. It is, therefore, appropriate to speak of an effect subgroup of order s as corresponding to an $(m-2)$-flat at infinity. In general, an effect subgroup of order s^k would corres-

pond to an $(m\text{-}k\text{-}1)$-flat at infinity, and the complete orthogonal treatment subgroup of order s^{m-k} can be readily written down, as explained above, from the equations to the k pencils of $(m\text{-}1)$-flats of which the k independent $(m\text{-}2)$-flats at infinity, having the $(m\text{-}k\text{-}1)$-flat at infinity as their common intersection, are the vertices. In fact, the effect subgroup of order s^k would be obtained by taking the product of the k effect subgroups, each of order s, corresponding to the k independent $(m\text{-}2)$-flats at infinity. If any effect subgroup of order s^k is taken as an alias subgroup, and all its elements set equal to the identity, the complete orthogonal treatment subgroup comprises a set of s^{m-k} treatment combinations appropriate for an arrangement in $1/s^k$ replicate. Each effect has then s^k aliases which are obtained by multiplication of one of its names by elements of the alias subgroup. In terms of parallel pencils of s $(m\text{-}1)$-flats, each corresponding to $s\text{-}1$ degrees of freedom for a main effect or interaction, it would follow that the alias subgroup of pencils will consist of $s^{k-1}+s^{k-2}+\ldots+s^2+s+1$ pencils, and the remaining $s^k(s^{m-k-1}+s^{m-k-2}+\ldots+s^2+s+1)$ pencils are divisible into $s^{m-k-1}+s^{m-k-2}+\ldots+s^2+s+1$ alias sets of pencils, each set containing s^k pencils.

As an illustrative example, let us consider a 4^4 design in $1/4^2$ replicate. Then one such design is obtained by taking the five pencils of 3-flats, *viz.* $x+2y+2z=0,1,2,3$; $y+2z+2w=0,1,2,3$; $x+3y+2w=0,1,2,3$; $x+z+3w=0,1,2,3$; and $x+y+3z+w=0,1,2,3$, where 0, 1, 2, 3 denote respectively the elements $\alpha_0, \alpha_1, \alpha_2, \alpha_3$ of GF(2^2), as the alias subgroup of pencils, to which corresponds the alias subgroup of order 16 given by

I, AB^2C^2, $A^2B^3C^3$, A^3BC, BC^3D^2, $B^2C^3D^3$, B^3CD, AB^3D^2, A^2BD^3, A^3B^2D, ACD^3, A^2C^2D, $A^3C^3D^2$, ABC^3D, $A^2B^2CD^2$, $A^3B^3C^2D^3$.

The complete orthogonal treatment subgroup to be used is

1, ac^3d^3, a^2cd, $a^3c^2d^2$, bcd^2, abc^2d, a^2bd^3, a^3bc^3, $b^2c^2d^3$, ab^2c, $a^2b^2c^3d^2$, a^3b^2d, b^3c^3d, ab^3d^2, $a^2b^3c^2$, $a^3b^3cd^3$,

which is obtained by taking the 16 treatment combinations corresponding to the 16 points lying on the 2-flat given by the equations

$$x+2y+2z=0 \text{ and } y+2z+2w=0.$$

Here the alias subgroup of pencils consists of the above 5 pencils, and the remaining $4^2(4+1)$ pencils of 3-flats are divisible into 5 alias sets of pencils, each set containing 4^2 pencils. It would be observed that the $1/4^2$ replicate of a 4^4 design gives main effects and two-factor interactions, or pairs of two-factor interactions, in some alias sets, and cannot, therefore, be considered to be of practical value unless two-factor interactions are ignored as of no importance.

For full details, the interested reader is referred to the author's paper on the subject to be published shortly elsewhere.

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ABNORMALLY DRY AND WET WESTERN DISTURBANCES OVER NORTH INDIA

By S. L. MALURKAR

(*Poona 5*)

WESTERN disturbances which produce rain in winter months in N.W. India are of great importance in agriculture, particularly for wheat in the Punjab. Some of the western disturbances give well-disturbed and abundant rain over the area, while others pass away without giving appreciable rain or even go dry. The obvious mode of explanation of the difference, by the insufficiency of moisture supply, begs the question to a certain extent. Upper air circulations due to the two western disturbances may *at first sight* appear to be similar (particularly when the extent of the weather charts is limited); but the resulting effects are widely different. A criterion was arrived at and used by the author for help in furnishing medium-range forecasts to agriculturists and aviators who need short-range forecasts.[1]

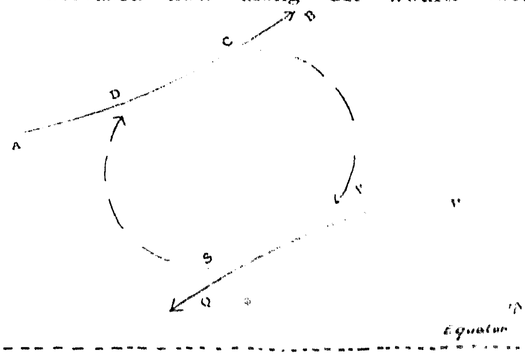
Western disturbances over India are due to the passage of complex low pressure areas or waves over North India under the influence of extra-tropical depressions. These areas, if dealt as such, are not easily understandable either as regards their effects or their motion. A simple method would be to treat the complex low pressure area as composed of a number of simple low pressure areas or successive secondaries with distinct identity and circulation.[2] All these secondary low pressure areas travel in an almost east-northeasterly direction, and in the course of the travel one or more of them may fill up or sometimes intensify. The upper air circulation and rain are due to the combined or resulting effect of the various secondaries at a place. When a primary extra-tropical cyclone passes at a higher latitude, the secondaries form at certain places, which are favoured by orography and the distribution of land and sea.[3] Some of these favoured places (with reference to India) are: the coastal region west of the Nile river; upper of south Egypt; Sudan and Red Sea; Gulf of Aden and the Oman Peninsula; North Arabian Sea off Mekran; East Arabian Sea off Kathiawar and Konkan; and occasionally the head of the Bay of Bengal. The lesser component of earth's rotation in the tropics compared with the higher latitudes probably needs that the secondaries form only when favoured by orography. The secondaries that develop in lower latitudes

(Sudan, Red Sea, off Mekran or off Konkan) affect India, and lack of rain in N.W. India would mean that the particular secondaries were not fully developed.

In the first three or four days of April 1944, a very active western disturbance passed over N.W. India and the rain it produced resembled a day when the S.W. monsoon extends to N.W. India. But it dried up in the course of the next couple of days and hardly showed the activity in N.E. India which one expected. From the clouding and other features, the disturbance could be located in Deltaic China on the 8th. In South Indian Ocean east of Madagascar, a deep depression was found on 7th, and it had moved from the east. Similarly in January 1945, the rainfall which was fairly good in N.W. India during the first ten days of the month fell off rapidly, and simultaneously a depression could be located in S. Indian Ocean. Due to depressions in S. Indian Ocean which formed in quick succession and moved westwards, there was a dry spell over N.W. India during the greater part of the next four or five weeks. It was, therefore, deduced that western disturbances were not quite active or even passed dry when there was a deep depression south of the equator (but not too far south and not widely separated in longitude)[1] or when the seasonal low pressure area south of the equator was more marked than usual. A tentative explanation of the mechanism involved in drying up the northern disturbance based on divergence and subsidence was given.[4] The dynamics of the process can now be given in relation to other known phenomena.

Just north of the equator, in the lower levels of the atmosphere, there is an easterly or east-northeasterly flow of air (N.E. Trades). At higher latitudes, there is a westerly or west-southwesterly stream. (The higher levels are not immediately under consideration.) The easterly winds become stronger when fresh 'pulses' or low pressure areas travel from the east and cross the equator to feed a southern cyclonic storm or a depression. The westerly winds at higher latitudes feed into the western disturbances or their secondaries as tropical air (T) and may strengthen (see Fig. PQ easterly, AB west-southwesterly). When there is such a juxtaposition in the northern hemisphere—an easterly at a lower latitude and a westerly at a higher latitude—the high pressure area in between divides itself into cells of high pressure, or a series of anticyclones. When there is no disturbance to the north or south of it, the anticyclone may be described as stationary in intensity and in approximate position (CRSD). The subsidence would be small and the air in it generally stable.

If the wind stream PQ becomes stronger due to a cyclonic storm south of the equator and the passage of 'pulses' from north to the southern hemisphere, the anticyclone becomes a developing or an increasing one. There would be a tendency for an increased flow of air along CR. The flow along SD may also be slightly increased, but as the passage of 'pulses' is almost *explosive* across the equator (shown by the squalls and thunderstorms) this point may be considered later. For the stream AB, the increased flow along CR would mean



divergence, one an actual due to separation from the original stream and the other one due to descent in latitude. Due to these two effects, the air gets very stable. As the rate of subsidence is greater in a developing anticyclone than in a stationary one as shown by Napier Shaw, the air in the anticyclone would be greatly stabilised. If there be a secondary of a western disturbance to which the stream AB is feeding, both the currents CB and CR speed up and may result in greater divergence. When N.E. Trades get stronger due to the fact that 'pulses' *are* feeding into a southern tropical cyclonic storm or depression or due to an intensification of the southern monsoon low, the air mass (along AB) that would normally have gone to feed the secondary of a western disturbance is attaining great stability and produces little weather in the shape of precipitation. If the southern depression is too far south of the equator (when no 'pulses' feed it from the north), or when it is widely separated longitudinally, the effect on the particular anticyclonic cell would be less, and it can be assumed that the western disturbance is not being affected from the southern hemisphere.

Regarding subsidence on a large scale in Peninsular India, the surface observations at the higher hill stations (Dodda-betta, Coonoor, Kodaikanal) show it by the very low humidities observed on some winter days there.[5] Hahn[6] has given instances of very low humidity at hill stations in Dutch East Indies (Sumatra, Java, etc.). With the help of Radio-sonde observations in these days, it is possible to actually notice subsidence at higher levels of the atmosphere over a wider area. There would not be any definite time sequence in the subsidence observation. The dot diagram[5] connecting the extreme dryness at Kodaikanal and the inversion layer at Poona (found by sounding balloons) is almost contemporaneous.

The sudden clearing up of the sky in Central parts of India when there is a depression south of the equator is so striking that a forecaster with a big chart can hardly escape noticing it.

Regarding the increased flow along SD due to the developing anticyclonic cell, though there is divergence in the easterly stream, there is also a latitudinal convergence as it is gaining in latitude. It is likely that some weather can be expected to the west of the

anticyclonic cell. This may perhaps account for *some* of the rain in the extreme south Peninsula when a southern depression is passing fairly near the equator.[7]

The 'pulses' or low pressure areas that travel from the east to feed the southern depression are not entirely unaffected by the secondary of the western disturbances over India. The western disturbance might 'pull' the low pressure area towards it and delay and occasionally prevent its crossing into the southern hemisphere. Whether the 'pulse' or low pressure area would be pulled towards the low of the western disturbance or to the southern depression depends very much on the relative intensities and positions of the tropical and extra-tropical depressions. The non-crossing of the 'pulse' to the southern hemisphere would create a 'break' in the monsoon there, weaken the depression and might sometimes kill or allow the depression to recurve.[8]

In the event of the western disturbance 'pulling' the low pressure area from the east to west even temporarily, the anticyclonic cell would once again be developing. The stream QSD which leaves the easterlies PQ is gaining in latitude and sometimes would cause weather; to the west of the anticyclonic cell there could be weather due to latitudinal convergence. But if it happens that the low pressure area or 'pulse' is not allowed to cross the equator at all, then there would be a general flow of the stream PQ along SD. In such an event, the resulting convergence would be more pronounced and the rainfall due to the secondary of the particular western disturbance which gets this feed would be greater than usual.[9] Such a contingency (the 'pulse' or the low pressure area not crossing to the southern hemisphere) can arise if the southern depression was filling up or recurved to an easterly direction.

On the other side of the developing anticyclonic cell CR, there would again be stability in the air along the region and the easterly side would be dry. (Rao Bahadur M. G. Subramanyam used to mention a belief held in Rajputana that there would be no rain in North Rajputana in winter so long as there was rain in S.E. Madras, and it is likely that the above is an explanation.)

Hence it follows:

(1) When there is a cyclonic storm in the South Indian Ocean moving from east to west and it is expected to continue strong or intensify and expected to retain a westward motion, it is safe to tone down the amount of rain due to a western disturbance in Upper India (the longitudinal separation must not be too much between the cyclonic storm and the western disturbance).

(2) When the southern cyclonic storm in the S. Indian Ocean is expected to fill up or recurve towards an easterly direction and the 'pulses' or low pressure areas from the east continue strong north of the equator, the western disturbance gives more rain than usual.

A similar criteria can be used at other places. When the N.E. Trades (in the northern hemisphere) which have had a sea travel continue to be strong, the extra-tropical depression just above that latitude would be more active or less active according as the N.E. Trades feed into or away from the depression. The extreme case of the situation is a recurved tropical cyclonic storm, which can give abundant rain or weather. The cyclonic storm recurves when the equatorial maritime air is cut off and the storm is guided by an extra-tropical depression in a higher latitude. In other words, the recurved depression can be considered as a secondary of the extra-tropical depression, which has had a good N.E. Trades feed. Such a criterion would be particularly useful in the Pacific Ocean.

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THE MILLS-NIXON EFFECT

By S. V. ANANTAKRISHNAN

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A GROUP of observations by Mills and Nixon[22] on substitution in the aromatic part of hydrindene led them to postulate a "fixation" of the bonds. Since then several other instances of a similar nature have been reported by other workers.[6,7,12,14] Both experimental and theoretical investigations have been reported and Rangaswami and Seshadri[26] have given a fairly comprehensive account of the experimental side.

The main lines on which the experimental investigations have proceeded make use of one or other substitution reaction in the aromatic part of a mixed system. In drawing conclusions from these observations, however, one cannot ignore the limitations of all interpretations based only on chemical reactions. This is clearly brought out by an analysis of the mechanism of the reactions that have been used. The principal reactions that have been

used are the following: (1) Bromination, (2) Nitration, (3) Ozonolysis, (4) The Claisen Rearrangement, (5) The Fries Reaction, (6) The Gattermann Reaction, (7) Coupling with Diazonium Salts and (8) Condensations in the presence of Aluminium Chloride.

The results of the experimental investigations are summarised in Table I.

TABLE I

Experimental Evidence of Fixation

Ring system	Reaction used	Results	Reference
Benzene	3, 4, 5, 8	Bond fixation	Levine and Cole[17] Baker[6] Baker and Lothian[7]
Naphthalene and Tetralin	4, 7 Halogen reactivity Skraup Synthesis	Evidence both for and against fixation of bonds	Claisen[10] Fries[14] Fieser and Lothrop[12] Marckwald[21] vanBraun and Grüber[32]
Hydrindene	1, 2, 3, 7	ditto	Borsche and Bodenstein[9] Arnold and Evans[4] Fieser[11] Macleish and Campbell[20] Sandin and Evans[28]
Fluorene	1, 2, 4, 5	Little fixation of bonds	Anantakrishnan & Hughes[3] Bergmann and Berlin[8] Lothrop[19]
Coumarins and Chromones	4, 5	Bond fixation	Baker and Lothian[7] Limaye
Anthracene	1, 7	Evidence both for and against bond fixation	Fries[14]
Phenanthrene	4, 7	Bond fixation	Fieser and Lothrop[12] Fieser, Young and Newman[13] Smith[31]

Taking the reactions in the order given, the position can be summarised as follows:—

1. The essential feature of bromination is that the reagent is the polarised molecule which behaves as an electrophilic reagent and a bromine atom is transferred as a positive ion with a sextet of electrons. The transition state even in the simple case of benzene involves contributions by seven valence bond structures.[33] A study of the reaction at higher temperatures have shown that the relative amounts of isomeric substitution products vary to a considerable extent.[34] The peroxide effect is another complication in polynuclear systems.[23] Any conclusions based on this reaction can at best be an approximation representing the position under the conditions of the experiment.

2. The usual experimental conditions for nitration conform to the initiation of attack by an electrophilic reagent and the conditions for the influence of groups should be analogous to the first reaction. The principal mechanisms that have been postulated for this reaction involve either an addition of nitric acid to the double bond in the aromatic part[25] or initiation of attack by the nitronium ion NO_2^+.[15] Kinetic studies as well as the physical properties of solutions of nitric acid under the usual conditions for the reaction are quite consistent with attack by the nitronium ion. The transition state here should involve an even more complex system than bromination. Further, it is obvious that the configuration of the aromatic system in the presence of a polarising field as at the instant of reaction cannot be the same in the absence of such a field.

3. The mechanism of ozonolysis in the case of poly-enes is still far from satisfactorily established. Results based on this reaction cannot, therefore, be considered unequivocal evidence for bond fixation.

4. The migrations of groups to the ortho-position have been used to a considerable extent. The Claisen rearrangement appears to have been used not a little because of the *apparent* absence of catalytic influences. The undesirable side reactions in the case of ethers of higher boiling point and the better yields with reduced polymerisation during rearrangement when basic solvents are used indicate the complex nature of the problem. The distinct differences noticeable between rearrangements involving the allyl group and of alkyl groups bring out the special features of the allyl group which should be taken into account in using this reaction as evidence for bond-fixation. The para rearrangement seems to require an intermolecular mechanism. Further investigation is clearly needed before one can consider the interpretations as a correct picture. Subject to this limitation, the reaction gives us an indication that bond-orders in the aromatic part of the mixed system or in a substituted benzene are probably not the same in the six-membered ring.

5. The Fries reaction differs from 4 in that the migrating group is an acyl, and definitely requires a catalyst. The relative unreliability of this reaction as a criterion for bond fixation is readily seen from the fact that the nature of the product is dependent on the structure of the ester, the temperature of the reaction, the solvent used and the proportion of the

catalyst used.[1] Existing data are inadequate in fixing a single mechanism; some of the mechanisms that have been proposed treat the reaction as an intermolecular one while others make it out to be an intramolecular one. The mechanistic uncertainty also reduces the value of this as a criterion for bond fixation.

6. The modified Gattermann reaction has been used in very few cases at best as a confirmatory test and with the meagre data no generalisation is possible.

7. Fieser and co-workers have used the coupling reaction with a number of compounds as a specific reaction for establishing bond fixation. If one can assume that Meyer's mechanism of coupling reactions of the diazonium compounds, is the correct one there is some justification in assuming Fieser's interpretation as a probable correct picture. The mechanism of these reactions has not been taken out of the field of controversy and it is necessary to examine if a different explanation of the observations is not possible. It should be stated, however, that of all the chemical evidence adduced in favour of the concept of bond-fixation this reaction is the one with the maximum degree of consistency.

8. These condensation reactions are of too complex a nature to be of much significance for diagnostic purposes at present.

In addition to these reactions physical measurements have also been pressed into service to elucidate the problem under discussion. These include dipole moments,[30] dissociation constants of acids,[1] oxidation-reduction potentials[5] and measurements of bond distances.[16] The first three have been used essentially as methods of comparative study and the results have not turned out to be very conclusive. The measurement of bond distances has not been very helpful either and the values obtained have been generally against any fixation of the double bonds in a specified position.

Before discussing the experimental facts, it is necessary to consider the theoretical treatment of the problem. Two different approaches have been made, one by Pauling and Sutton[24] and the other by Longuet-Higgins and Coulson.[18] Both treat only the specific example of hydrindene and the final results are quite different. The concept of Mills and Nixon[22] that the angles between two single bonds in benzene are different from that between the two double bonds which formed the basis of their suggestion of bond fixation is to some extent at the background of the treatment by the earlier authors. In setting up the secular equation for the wave-functions, Pauling and Sutton ignore the excited structures and consider only the relative contribution of the Kekule forms, the matrix elements including the angle between the ortho-valencies and a bending force constant. The secular equation is solved by assuming that the value of the bending force constant for the C–C bond is the same as that of the C–H bond in HCN and a ratio of the coefficients of the two Kekule structures is calculated to be about 1·05. Using this value, the ratio of the rates of substitution in positions 4 and 6 in hydrindene is derived and the values of the yield are found to be in accord with the experimental observations of Mills. (*loc. cit.*).

Longuet-Higgins and Coulson treat the problem by the method of molecular orbitals. A fundamental difference in their treatment of the problem lies in the assumptions in evaluating valence angles and bond forces that all the aromatic bonds are of one fixed length, all other carbon-carbon bonds are of a different fixed length, and the energy to form the valence angle at a trigonal carbon is the same whether the linked atoms are carbon or hydrogen. The total energy of the electrons is calculated by the method of Lennard Jones and the resonance integral is obtained as a function of the bond lengths and the force constants of the single and double carbon-carbon bonds. In the absence of standard values of the angular deformation constants needed in the calculations of the stresses involved, the value has been calculated assuming the assignment of the frequency in the propane molecule and treating the system as a non-linear triatomic molecule XY_2. In a similar manner, the deformation constant for a trigonal carbon has been obtained by a comparison of the bending frequency of propane with that of propylene. A result of the analysis by these authors lead to the observation: "Hence we must abandon the idea that the 4-bond in hydrindene is of a higher order than the 3-bonds and look elsewhere for an explanation of the greater reactivity of the 6- than 4-position in hydroxy hydrindene."

It is interesting to recall here the difficulty in reconciling the electron diffraction results of Kossiakoff and Springall[16] with the dipole moment observations of Sidgwick and Springall. It has been found necessary to abandon the hypothesis of the additivity of bond moments and to postulate additional resonance states in order to account for the apparent discrepancies.

Before we can take up the question of a possible explanation for the experimental observations, attention should also be drawn to Baker's observations on chelation which have played not an insignificant part on this subject of bond fixation. The strength of this evidence depends essentially on the unconscious assumption of a covalency of two for hydrogen. When one recognises that the hydrogen bond whether intermolecular or intramolecular is essentially an ionic bond and a chelate ring can be considered as a mobile electron system, this turns out to be of doubtful value in treating any bond system of the type under consideration as a static system. The question again becomes quite an open one.

It is possible to account for the different observations without postulating any bond fixation. Attention has been drawn early in this account to the limitations of each of the reactions that have been used. Any explanation must take into account the nature of the reaction and whether one approaches the problem from the collision theory or the transition state theory, the factors of diagnostic interest in the rate constant equation are the frequency factor and the energy of activation.

The paucity of accurate kinetic data precludes any quantitative analysis but an approximate computation may none-the-less be attempted. The substitution reactions that have been used may be expected to require an energy of activation of the order of 20 kilocalories, the values being different for the

different positions—ortho-, meta-, para-, etc. It can be shown that even a small difference in the activation energy of 5 per cent. will lead to difference in rate of substitution of more than a power of 10. This in turn will be reflected in the yield of the product. Combined with the normal errors in the estimates of yield in an average preparation of an organic compound, secondary products of a side reaction can be readily missed if the proportion is small, as will be the case here. One can legitimately conclude, then, that the experimental observations and theoretical requirements of the systems of the type of hydrindene do not require a static picture of the type postulated by Mills and Nixon. The fusion of a saturated ring to an aromatic system need not necessarily involve any appreciable change in the bond angles or in the bond distance of the common bond. The relative ease of substitution can be readily accounted for by a consideration of the polarising force of the substituents as well as the reactant molecules. There is no doubt that further investigation and accurate data are needed for a full appreciation of the problem.

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GEOMAGNETIC STORMS

GEOMAGNETIC activity during the quarter January-March 1947 was on the increase as compared with the previous quarter. Some details of the geomagnetic disturbances recorded at the Alibagh Magnetic Observatory during the quarter January-March 1947 are given in the following table in which t_0 and t represent the time (I.S.T.) of commencement of the disturbance and its intense phase respectively, and T the duration of the intense phase expressed in hours. The ranges in the three different elements (D, H and V) of the earth's magnetic field have also been given, D, in minutes of arc, H and V in γ where $1\gamma = 10^{-5}$ gauss. The maximum *k-index* recorded during the disturbances have also been given.

Date	t_0	t	T	Range D	Range H	Range V	k_m	Nature of commencement
1947	h. m.	h. m.	hrs.	min.	γ	γ		
January, 16–17	8 57	8 57 on 16th	5½	5·8	153	58	6	Sudden
January, 24–27	About 10 · 00	10 21 on 25th	7	5·8	258	64	6	Gradual
February, 16–17	8 29	15 38 on 16th	9	5·1	366	88	8	Sudden
March, 2–3	9 29	13 45 on 2nd	7	7·8	434	77	8	Sudden
March, 8–9	About 11 30	11 30 on 8th	12	4·1	330	45	6	Gradual
March 15	14 12	14 12	8	4·6	199	35	6	Sudden

LETTERS TO THE EDITOR

NUTRITIONAL REQUIREMENTS OF A SACCHAROMYCES Sp.? ISOLATED FROM COCONUT TODDY

A sample of coconut toddy obtained from Ceylon was found to contain an unusually large-sized yeast. Attempts to isolate this organism on wort-agar proved unsuccessful. It, however, grew on a synthetic medium fortified with thiamin, riboflavin, pyridoxin, pantothen, niacin, biotin, inositol and p-amino-benzoic acid.

It was, therefore, of interest to determine the essential vitamin and other nutrilite requirements. The big size of the cell ($15\,\mu \times 5\,\mu$) fecilitated cytochemical investigation of the syndromes of avitaminosis.

Basal media with no vitamins were compounded with solutions of salts, citrate buffer (pH 4·6), ammonium sulphate (0·4 gm./100 ml) and glucose (5 gm./100 ml.). The all-vitamin media, those lacking a given vitamin or an essential amino-acid were compounded, 5 ml.

Table I
Yeast-Growth on Media With and Without Essential Nutrients

Media composition	Percentage of absorption	Average size of cell in microns	Remarks
Basal medium (no vitamins) ..	16	9·5×3	Vacuolated cells
B. M. with all Vitamins & amino acids ..	55	15·0×5	Granulated cells
Lacking thiamin ..	50	12·5×3	Thin cells
Lacking riboflavin ..	53	15·0×5	
Lacking pyridoxine ..	53	12·5×5	Highly vacuolated
Lacking calcium pantothenate ..	41	12·5×5	Cytoplasm thin
Lacking nicotinic acid ..	16	12·5×5	Few granules
Lacking *p*-amino-benzoic acid ..	53	10·0×3	Granulated cells
Lacking biotin ..	37	12·5×5	Refractive granules
Lacking inositol ..	24	12·5×5	Less of cytoplasm
Lacking choline ..	50	12·5×5	-
Lacking *l*-aspartic acid ..	53	10·0×5	Large vacuoles
Lacking *l*-tryptophane ..	52	12·0×5	Thin cells
Lacking *l*-cystine ..	50	12·0×5	
Lacking *dl*-methionine ..	53	12·0×5	
With Lily liver extract ..	62	12·5×5	Granulated cells
With inositol, niacin, biotin and calcium pantothenate ..	53	12·0×5	Granulated cells

of each sterilised and distributed into sterile test-tubes (22 mm. × 150 mm.), and inoculated with 0·5 ml. of a uniform yeast suspension of a 24-hour culture containing 0·4 mgm. of wet yeast per ml. The tubes were placed at a slant and incubated at 28° C. for 24 hours.

Turbidities representing growths were photoelectrically measured and expressed as the percentages of absorption (see Table I).

The results show that:—

(1) Nicotinic acid and inositol are the essential vitamins for the growth of the organism; biotin and pantothen are stimulatory. Lack of these vitamins result in vacuolation or in a poor differentiation of cells.

(2) Other vitamins exert little effect on growth. This is supported by the fact that the growth-rate on a basal medium fortified with only niacin, inositol, biotin and pantothen is as good as that on the all-vitamin medium.

(3) The microscopic appearance of the two cultures are similar showing that the four vitamins satisfy all the normal requirements of the organism.

(4) Liver extract which has given a significantly higher growth and induced a distinctive microscopic picture, appears to contain a growth factor or factors essential to the organism—vitamin or amino acid—other than those investigated.

(5) The adaptability of this yeast as a test organism for the microbiological assay of niacin and inositol is indicated.

Our sincere thanks are due to Sir J. C. Ghosh for his kind interest.

T. N. Ramachandra Rao.
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Section of Fermentation Technology,
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April 30, 1947.

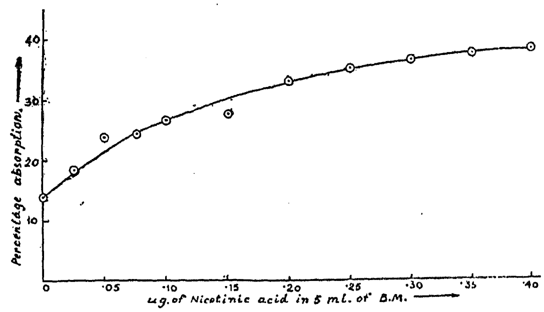
MICROBIOLOGICAL ASSAY OF NIACIN WITH A SACCHAROMYCES Sp.? ISOLATED FROM COCONUT TODDY

The vitamin requirements of this organism have been determined and the indispensability of niacin and inositol for its growth established.[1] It was of interest to examine the adaptability of the organism for the assay of niacin, and determine the range of concentration which could be estimated.

Basal media containing all vitamins but niacin were compounded. 100 ml. of the medium contained:—Glucose 5 gms., ammonium sulphate 0·4 gm., *l*-aspartic acid 10 mg., *l*-tryptophane 1·2 mg., *l*-cystine 4 mg., *dl*-methionine 4 mg., thiamin 80 µg, riboflavin 80 µg, pyridoxine 80 µg, pantothen 80 µg, *p*-amino-benzoic acid 80 µg, biotin 100*m* µg inositol 200 µg, solution of salts 12·5 ml. and citrate buffer (pH 4·6) 10·0 ml.

Aliquots of the medium (2 ml.) were distributed into sterile tubes (22 mm. × 150 mm.), graded amounts of niacin added and the volume made up to 4·5 ml. with sterile water. The tubes were inoculated with a washed and uniform suspension of the organism (previously grown on an all-vitamin medium for 24 hours) and incubated for 24 hours at 28° C. Growths of the organism were photoelectrically measured and the results expressed as percentages of absorption (see Table I and Fig. 1).

Medium with µg Niacin	0·0	9·025	0·05	0·075	0·1	0·15
Per cent. absorption	14·5	18·5	24·0	24·5	26·0	27·0
Medium with µg Niacin	0·20	0·25	0·3	0·35	0·4	0·5
Per cent. absorption	32·5	34·5	36·0	37·0	37·5	38·5



It is concluded that (1) the organism is adaptable for the assay of niacin and (2) the assay-range lies between 0 and 0·04 µg per ml., and this method appears to represent a more sensitive method of assay than others so far known.

Our grateful thanks are due to Sir J. C. Ghosh for his kind interest.

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April 30, 1947.

1 Ramachandra Rao, Mistry and Sreenivasaya, *Curr. Sci.*, **1947**, **16**, 145.

PHYTOPHTHORA PALMIVORA BUTLER ON *CYPHOMANDRA BETACEA* SENDT. AND *CARICA PAPAYA* LINN.

Two isolates of *Phytophthora* were obtained from two independent sources, one from the stem of tree tomato (*Cyphomandra betacea* Sendt.) with a patch canker from the Fruit Station at Burliar at the foot of the Nilgiris, the other from a rotten hollow stem of a papaw tree in Coimbatore.

Both these isolates did not produce any oospores in pure culture even after three months although sporangia and chlamydospores were produced in abundance in old cultures. Therefore, they were grown in paired cultures with known plus and minus strains of *P. palmivora* available in the Government My-

Isolate with which the *C. betacea* and *Carica papaya* *Phytophthoras* were grown in paired cultures	Plus strain					Minus strain			
	Areca, S. Kanara	*Areca*, Bombay	*Colocasia*, S. Kanara	*Tomato*, Coimbatore	*C. betacea* Burliar	*Ca. papaya* Coimbatore	*H. esculentus*, Coimbatore	*Spondias* S. Kanara	*Areca*, Bombay
Cyphomandra betacea isolate	0	0	0	0	0	X	X	X	X
Carica papaya isolate	X	X	X	X	X	0	0	0	0

X — Cospores formed within four days; 0 — no oospores formed.

cologist's stock culture collection at Coimbatore. The results of these trials are set down below in a tabular form:

These results show that the *C. betacea* isolate is a plus strain of *P. palmivora* and the other a minus strain.

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Agriculutral Research Institute,
Coimbatore (S. India),
May 15, 1947.

ON THE ANALYSIS OF BLOOD-GROUP DATA OF PUNJABIES AND MALDIVIANS

KALRA[1] has examined the blood groups of 2,500 Punjabies at I.M.H., Rawalpindi, and of 211 Maldivians at Adder Atoll. This note gives the results of statistical analysis of the data collected by him.

Let p, q and r represent the true gene probabilities of the three allelomorphic genes A, B and O respectively, so that $p+q+r=1$. These true values for Punjabies and Maldivians are, however, unknown, and have, therefore, to be estimated from the samples examined by Kalra. The most efficient estimates of the true gene probabilities are readily obtained by the use of the method of maximum likelihood which has been discussed in full detail by Stevens.[2]

Using the maximum likelihood estimates of the true gene probabilities, the conformity of the blood-group data for Punjabies and Maldivians with the genetical theory advanced by Bernstein[3,4] has been tested by applying the χ^2-test with one degree of freedom. For Punjabies, $\chi^2 = 2\cdot25782$ ($0\cdot20 > P > \cdot10$) and for Maldivians, $\chi^2 = 0\cdot10361$ ($\cdot90 > P > \cdot80$). Neither of these values is, therefore, significant at the customary 5 per cent. level of probability. Thus, for both Punjabies as well as Maldivians, the blood-group data are in good agreement with Bernstein's genetical theory.

The maximum likelihood estimates of gene probabilities for Punjabies and Maldivians, along with their standard errors, are presented in the annexed table.

Column 3 of this table gives the estimated gene probabilities, Column 4 the corresponding variances and Column 5 the estimated gene probabilities and their standard errors, both multiplied by 100. It would appear from this table that the proportions of A and B genes in the case of Punjabies are significantly higher than in the case of Maldivians. However, the proportion of O genes for Punjabies is significantly lower than that for Maldivians.

Dept. of Agriculture, U.P.,
Lucknow, K. KISHEN.
April 25, 1947.

1. Kalra, S. L., *Curr. Sci.*, 1947, **16**, 92. 2. Stevens, W. L., *Ann. Eugenics*, 1938, **8**, 362. 3. Bernstein, F., *Klin Wschr.*, 1924, **3**, 1495. 4. —, *Z. indukt. Abstamm. -u. Vererblehre*, 1925, **37**, 237.

Caste	Gene	Estimated Probability	Variance	Percentage and standard error
1	2	3	4	5
			$\times10^{-5}$	
Punjabies ..	O	·5942048	5·6601849	59·420 ± 0·752%
	A	·1752423	3·1879764	17·524 ± 0·565%
	B	·2305529	4·0625955	23·055 ± 0 637%
			$\times10^{-4}$	
Maldivians ..	O	·7653750	4·58493	76·538 ± 2·141%
	A	·1051228	2·35898	10·512 ± 1·536%
	B	·1295022	2·86833	12·950 ± 1·694%

EFFECT OF CERTAIN FACTORS ON THE PULSE FREQUENCY OF A RELAXATION OSCILLATOR

AN audio-pulse frequency oscillator working on the relaxation oscillations of a thermionic valve controlled by the constant 'CR' of the time circuit has manifold applications. The device is usually a condenser shunted by a high resistance suitably placed in the oscillator valve circuit. A number of arrangements have been described by many authors,* but none seem to have paid much attention to the effect of other factors on the pulse frequency apart from the constant 'CR'. The object of the present communication is to give the effect of

two factors (*a*) the inclusion of a small inductance in the time circuit and (*b*) the filament current, on the pulse frequency.

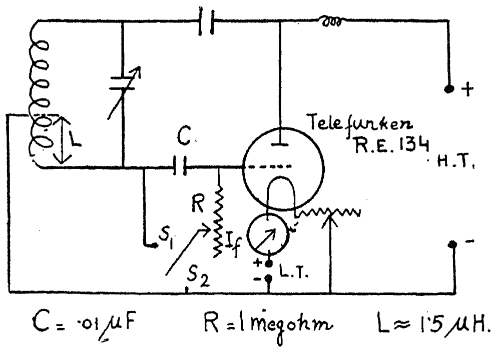


FIG. 1

The oscillator used for the investigation was a parallel fed Hartley Type one, suitable for short-wave range of 50 to 150 metres, the pulse generating device being a fixed condenser C of ·01 M.F. capacity shunted by a variable carbon resistance having maximum valve of one megohm. The switch in position S_1 shunts the condenser C by R directly, whereas in position S_2 through small inductance L. Loosely coupled crystal wave-meter serves for the detection of pulses. The audio-frequency of the note was determined with the help of standard tuning forks and a sonometer. Throughout the investigation the carrier wave-length was maintained at a fixed value. Variation of pulse frequency '*f*' with resistance R was studied for two different filament currents and the two positions S_1 and S_2 of the switch. However, the filament current cannot be changed much from the rated value without affecting the performance of the valve. Results are graphically shown in Fig. 2. The points marked as ⊙ correspond to the position S_1 and that as + to the position S_2 of the switch.

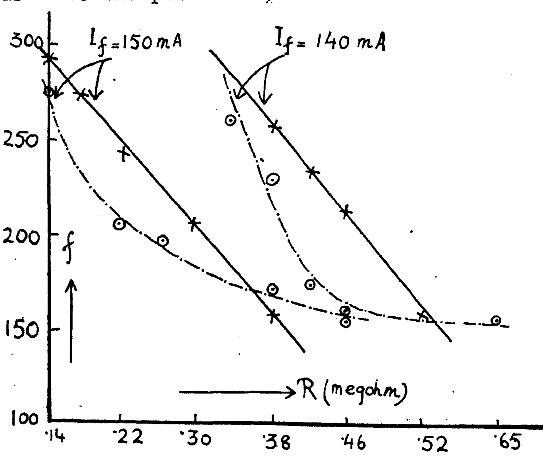


FIG. 2

It is seen from the graphs that if the usual method of directly shunting the condenser is used then the variation of pulse frequency '*f*' with resistance R is non-linear. The effect of inclusion of a small inductance in the time circuit is to make the variation linear.

The reduction of filament current has no effect on the range of pulse frequency which is 160 to 300 cycles in the present case; but higher values of resistance R are necessary to get the same range.

Department of Physics,
Dungar College,
Bikaner,
March 8, 1947.

V. L. TALEKAR.

* 1. Appleton, Watt and Herd, *Proc. Roy. Soc.*, 1926, **111**, 673. 2. Schafor and Gordall, *Proc. Inst. Rad. Eng.*, 1932, **20**, 1131. 3. Morgen, *Rev. Sci. Inst.*, 1938, **9**, 180. 4. Morin, *Compt. Rend.*, 1938, **206**, 1580.

PARTITIONS OF AIR MASSES IN THE TROPICS, AND THE I.T.F.

THE Norwegian school of meteorologists expounded and developed the Polar-Front theory of extra-tropical cyclones. An active outbreak of cold polar air across this semi-permanent polar front led to the formation of the cyclones. The approximate positions of the semi-permanent Polar, Arctic and Antarctic fronts were given. An equally simple picture for a semi-permanent front given by the same school is the Inter-tropical-front (I.T.F.) representing the belt or region of convergence of the trade-winds from the two hemispheres. This line was represented as a broken line circling round the globe.[1] Willett has made the line a bit more continuous or unbroken.[2] It is very nearly the pressure equator. In Indian area, Willett has passed the line in summer through the seasonal low pressure area. But in the corresponding North American area, the line is kept away from the seasonal low, and drawn nearer the geographical equator. The behaviour of "Hurricanes" of West Indies must have been responsible for this change.

In India, the importance of this partition of the trade-winds from the two hemispheres has been implicit in Eliot. In describing the passage of Typhoons of the China Seas into the Indian area, the position of this partition has been found very useful by Doraiswamy Iyer[3] who has described its position from month to month.

The weather in the tropics needs three air masses—Equatorial Maritime air (Em.), Far-Eastern Transitional or Mixed air (Tr.) and Tropical Continental (Tc.) or Tropical Continental-Martime air (Tcm.). In several papers, these air masses have been described and their properties developed.[4]

During the northern summer Em. has a southerly component; the Tr. may have components from both north and south according to the geographical position and the Tc. is from W. or W.N.W. All these three air masses are essential, and without any one of them a monsoon depression, a tropical cyclonic storm or a tropical depression cannot form in the strict sense.[5]

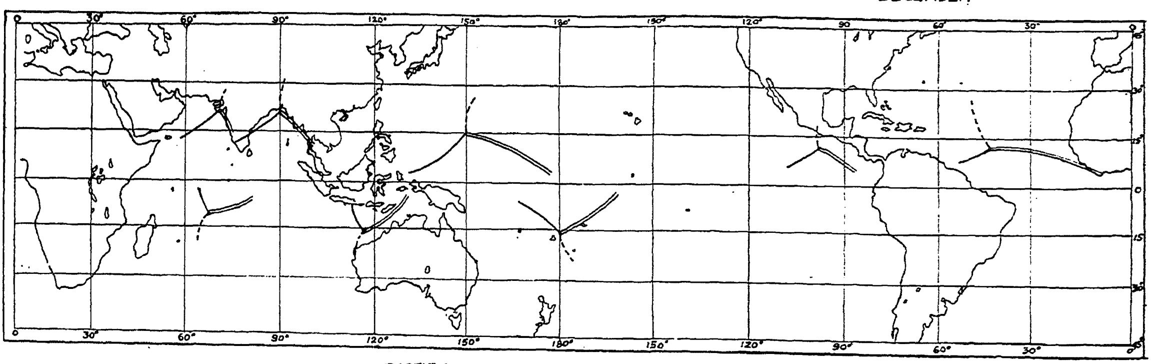
The main criterion of drawing the I.T.F. is the direction of the wind. It separates at some places Em. and Tr. and at others Em. and Tc. or Tcm. The partition between Em., which

can be made easily unstable, and the hot, almost-saturated, more stable Tr. can show clouds, weather and squalls over a wide stretch. In the partition of Em. and Tc., it may show a few thundershowers or even a scatter of only dry thunderstorms. Between different portions of the I.T.F., there would be distinct differences and the utility for a forecaster also would not be equally satisfactory. With three air masses which go to determine

and Pisharoty, "Evidence of three air masses from temperatures aloft in Tropical Cyclones" (in Press). —, "Abnormally Dry and Wet Western disturbances over N. India" (in Press). —, "Air Mass interpretation of Sen's Vortex method of Weather Forecasting", (in Press). 5. —, *Curr. Sci.*, 1947, **16**, 14. 6. Gibbs, *Synoptic Studies in Australian Met.* 7. Malurkar, Occasional Distant Weather Information and Forecasting" (in Press).

PARTITION LINES IN THE TROPICS

NORTHERN HEMISPHERE JUNE — SOUTHERN HEMISPHERE DECEMBER



PARTITION BETWEEN Em AND Tc OR Tcm
" " Em AND Tr
" " Tr AND Tc OR Tcm

tropical weather, it is hardly possible to represent the semi-stationary conditions by a single front. Gibbs[6] tried a compromise by an extra front called "Tropical front" which, when it combined with the I.T.F., indicated tropical depressions or cyclonic storms. It would be only logical to draw partitions of the three air masses over the Tropical belt as an idealised condition. An active outbreak of the various air masses across these fronts (particularly Em.) would be favourable for unsettled conditions and for development later of a tropical cyclonic storm or monsoon depression.

The available climatic information has been used, and the partitions for the months of June and December have been drawn on a single diagram of the Tropical belt. The partitions in the northern hemisphere represent the conditions in June, while the partitions in the southern hemisphere represent the conditions in December. As tropical weather comes from the east,[7] the map is drawn with the Pacific Ocean in the middle.

The fairly strong circulation south of the equator in the Atlantic and the Eastern Pacific Oceans, and the extension of the seasonal highs to within a few degrees of the equator prevent any partition lines being drawn. In other words, tropical cyclonic storms do not form there.

Poona 5,
April 19, 1947.

S. L. Malurkar.

1. S. Petterssen, "Weather Analysis and Forecasting," 1940, pp. 270 and 272. 2. H. C. Willett "Descriptive Meteorology," 1944, pp. 192–93. 3. *Mem. Ind. Met. Dep.*, **26**, p. 98 (Discussion) and references to Eliot. 4. Malurkar, "Forecasting Weather in and near India" released Nov. 1945, p. 34 *et seq.*; and p. 87 *et seq.* Malurkar

A MOSAIC DISEASE OF BRINJAL (*SOLANUM MELONGENA* LINN.)

A mosaic disease of brinjal (*Solanum melongena* Linn.) was of fairly widespread occurrence in 1946 at Delhi. The chief symptoms are bright green mosaic mottling and malformation of the leaf (Figs. 1-14) such as puckering and crinkling associated with abnormal and incomplete growth of the lamina; occasionally fine, pale, straw-coloured, concentric, irregularly-shaped rings develop on the leaf. In some cases the midrib or its branches protrude beyond the lamina (Fig. 12), while in others the leaf is completely modified into a filamentous structure. There is considerable reduction in the development of flowers and fruits.

To determine if the disease was graft-transmissible the scion from diseased brinjal was grafted on healthy plants of brinjal, tomato and tobacco, raised in the insect-proof house. Twenty-four grafts on brinjal, fourteen grafts each on tomato and tobacco were made; new growths arising from axillary buds on the stock showed typical symptoms of the disease in all the grafts (Fig. 16).

Inoculation of brinjal, potato, tomato and tobacco plants by rubbing the expressed sap from diseased plants or with insect needles previously dipped in the inoculum failed to transmit the virus.

Myzus persicæ Sulz. and *Empoasca devastans* Dist. were commonly observed on diseased brinjal plants. Two methods were employed to determine if the disease was transmitted by the agency of these insects.

(*i*) They were transferred directly from a badly affected plant to healthy brinjal, potato, tomato and tobacco plants raised in the insect-proof house.

(ii) They were introduced in a microcage and allowed to feed on a diseased plant for a period of 24 hours and then liberated on healthy plants raised in the insect-proof house.

Each of these plants was covered with a muslin cage.

FIG. 1–14. Various types of malformation in the leaves of brinjal badly affected by mosaic disease.

FIG. 15. a young healthy leaf.

All the brinjal and tomato plants on which *E. devastans* were liberated after feeding on diseased plants showed typical symptoms of the disease in 24 to 37 days, while the potato and tobacco plants remained free from the disease; all the four hosts on which *M. persicæ* were liberated after they were fed on diseased plants remained healthy. Control plants were free from the disease.

FIG. 16. A graft with healthy stock of tomato and diseased scion from a badly affected brinjal plant; *a*, point at which the diseased scion was grafted.

Two virus diseases of brinjal have been reported from Rumania the symptoms of which are different from those observed in Delhi; Savulescu *et al.*[1] described the disease as partial chlorosis causing mottling and dwarfing of the leaves while Alexandri[2] observed a severe mosaic with yellow interveinal lesions. In the second case the basal leaves of mature plants are the first to show the disease symptoms which spread from the base upwards. Alexandri succeeded in transmitting the virus mechanically and suspected the aphid *Myzus persicæ* to be the probable vector.

Insect transmission experiments show that the jassid *E. devastans* can transfer the disease from brinjal to brinjal or tomato.

Experiments on host-range of the virus and transmission of the disease by seed are in progress.

Thanks are due to the Imperial Entomologist for identifying the insects.

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and Plant Pathology,
Indian Agricultural Research
Institute, New Delhi, S. P. RAYCHAUDHURI.
March 26, 1947.

1. Savulescu, Sandu-ville, Rayss and Alexandri-*Int. Cer. Agron. al Romaniei*, **1934**, **12**, **93**. 2. Alexandri, *Hommage an Professeur E. C. Teodorescu*, Bucharest, **1937**, **12**.

A MOSAIC DISEASE OF *VIGNA CATJANG* WALP.

In October 1942, some plants of *Vigna catjang* Walp. grown on the Agricultural College Farm, Poona, exhibited mosaic symptoms. Under controlled conditions in the glasshouse, the virus could be transferred to healthy plants by inoculation of the sap.

The symptom of the disease in the field is green mosaic. The leaves are malformed and reduced in size, and the dark green areas are interspersed in the light green (Fig. 1). At a later stage of development, the disease becomes severe, and the leaves show chlorosis with small green areas dispersed over their surface. In the glasshouse, severe chlorosis of th leaves does not manifest itself on inoculated plants. Diseased plants bear only a few pods, which are small and show broad stripes of light and dark green colour on their surface. Such pods contain a few seeds each.

FIG. 1. Leaf of *Vigna catjang* affected by mosaic.

Transmission.—The virus is sap-transmissible and infection is rendered much easier by the addition of 600-mesh fine carborundum to the inoculum.

In transmission tests with *Aphis gosypii* Glover, *A. medicaginis* Koch. and thrips, which are commonly found feeding upon *Vigna catjang* Walp., *A. gossypii* and thrips failed to transmit the virus, whilst *A. medicaginis* transmitted it to about 36 per cent. of the plants colonised with the infective adults of this species.

About four per cent. of the commercial seed of *Vigna catjang* produced infected seedlings when grown under controlled conditions in the glasshouse.

Dilution end-point.—The dilution end-point of the virus in crude sap lies between 1 : 50,000 and 1 : 10,000.

Thermal inactivation.—The virus withstands exposure for ten minutes at 85° C., but is inactivated at 90° C.

Resistance to ageing.—Infectivity of the virus was lost after fifteen days at laboratory temperature (24° C.), but the virus was still active after nine days.

Host range.—Besides *Vigna catjang*, the virus infects *Vigna sinensis*, *V. sesquipedalis*, *Phaseolus lantanus* and *Canavalia ensiformis*. Several other leguminous plants and *Nicotiana tabacum*, *N. glutinosa* and *Zinnia elegans* were not infected when inoculated with the virus.

McLean[1] has reported a mosaic disease of cowpeas (*Vigna sinensis*), and Snyder[2] has described a similar disease of asparagus bean (*Vigna sesquipedalis*). Both these diseases resemble catjang mosaic described in this note, as regards the symptoms produced by them on their hosts, the mode of transmission by sap, by seed and by aphid, and the restricted host range, but they show a marked difference from the latter in respect of the physical properties. Accordingly, catjang mosaic virus is considered distinct from cowpeas and asparagus bean mosaic viruses. Vasudev[3] has also described a mosaic disease of *Vigna catjang* (Punjab cowpea type 1), but he did not investigate its physical properties or its host range. He has given no information either on the transmission of the virus by seed or by insects. Similarly, Dale[4] has described a mosaic disease of *Vigna unguiculata* L., but he has not studied its transmission by insects or by seed, nor has he described the physical properties of the virus. In these circumstances it is not known whether these two latter investigators were dealing with the virus described in this note.

This work is being carried out under a scheme financed by the Indian Council of Agricultural Research.

S. P. CAPOOR.
P. M. VARMA.
B. N. UPPAL.

College of Agriculture,
Poona.
April 10, 1947.

1. McLean, D. M., *Phytopath.*, 1941, **31**, 420. 2, Snyder, W. C., *Ibid.*, 1942, **32**, 518. 2. Vasudeva, R. S., *Indian Jour. Agric. Sci.*, 1943, **12**, 281. 4. Dale, W. T., *Trop. Agriculture*, 1943, **20**, 228.

STICK-LAC AS ILLUSTRATED IN 1567

Garcia da Horta, Physician to the Portuguese Governor of India, published a work, *Colloquios dos Simplices e Drogas*, at Goa in 1563. It was translated into Latin by C. Clusius, with the title *Aromaticum et Simlicium* and printed at Antwerp in 1567. The Latin translation contained three illustrations of stick-lac which were absent in the original.

Unfortunately the majority of workers on lac even to this day believe that there is only one species of lac insect; so, for them, the question does not arise as to the identification of the specimen illustrated by Garcia-Clusius. All along the western coast, and therefore also in Goa, it is only *Lakshadia communis* which occurs. Garcia writes, "Here in Goa a boy brought me a branch of a tree which the Deccanis call Ber (*Zizyphus*) ...... it bears (but) little lac." Probably Garcia had his illustrations made from this material, the first he ever saw in the natural condition. But Fig. 1 shows the twig without any thorns, which should be present on Zizyphus. However, within the short length shown in Fig. 1, they may be absent. At the top of Fig. 1 the encrustation from either side does not fuse; such an intervening space is typical of *L. communis*.

Fig. 2 is reproduced natural size with an arrow added, showing a piece of extra lac encrustation at the top of Fig. 2. Clusius does not explain his illustrations, nor has he numbered or lettered them; the figures serve more or less like decorations. The original drawings were possibly made by an artist, rather than by Garcia himself, which explains the anomaly in the picture (Fig. 2).

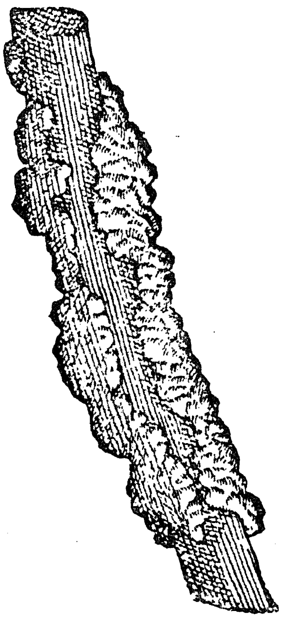


FIG 1

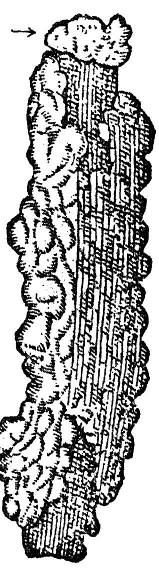


FIG. 2

Biochemical Laboratory,
Osmania University,
Hyderabad (Dn.),
April 16, 1947.

S. MAHDIHASSAN.

HEAT TREATMENT OF GODOWNS

RAHMAN[1] recommends 'superheating' for disinfesting empty godowns, but Pruthi and Singh[2] speak only of super-heating of grains and not of godowns. In the course of a trial in a godown in Bangalore, the writer experienced some serious reactions due probably to breathing in of carbon monoxide. This note is intended to caution workers, that in undertaking such work, protective devices must be employed.

Two bags of infested grains were spread in a corner away from the fire in a terraced room of 1,952 cubic feet. A fire was started at 9-30 a.m. with 30 lbs. of charcoal. The temperature of the room was recorded every half-hour.

Time	*Temperature* (° F.)
9-30	80°
10-0	85°
10-30	99°
11-0	104°
11-30	110°
12-0	110°
12-30	120°

(After 12-30 p.m., for reasons noted below, the room could not be entered into.)

At 12-30 p.m. the remaining charcoal was piled on the fire and the room sealed. It was opened two days later, and examination of the grain showed that all species infesting it, *viz.*, Calandra, Tribolium, Rhizopertha and Bruchids, were unaffected by the treatment, and were alive and active. 8 lb. of unburnt charcoal were recovered from the dead fire.

The main reason for the treatment proving ineffective against the insects in this experiment is obviously that the final temperature attained was probably not much more than 120° F. against 152° F. stated as necessary by Rahman. The experiment, when compared with Rahman's, also shows that the final temperature rather than the extent of rise determines the lethal effect on insects.

The writer had no protection when he entered the room for a few minutes every half-hour, and experienced certain disturbing symptoms due probably to taking in of carbon monoxide. These symptoms began at 11-30 a.m., about a minute after entering the room. There developed a sudden dizzy feeling in the head, a violent thumping of the heart and lightness in the limbs with intense perspiration all over; managed to reach the door with unsteady steps and slithered down in a semi-conscious condition outside. In the subsequent half-hours, these symptoms came on immediately on entering the room; in addition, light-headedness and a violent shaking of limbs were also experienced. After 12-30 p.m., it became impossible to get into the room. It took about three hours of rest in fresh air for these symptoms to wear off, though general weakness continued throughout the day.

This experience could have been avoided if mechanical devices of some kind (such as a suitable respirator, gas-mask, automatic temperature recorder, etc.) had been employed to render the operation entirly safe. Such protection, though probably implied is not mentioned by Rahman. If super-heating is undertaken as a regular method for disinfesting godowns, it is essential to be equipped with protective devices.

My grateful acknowledgments are due to Mr. B. Krishnamurti, Entomologist to the Government of Mysore, for valuable suggestions in writing this note.

Entomological Laboratory,
Department of Agriculture,
Bangalore,
April 22, 1947.

D. SESHAGIRI RAO.

1. Rahman Khan, A., *Indian J. Agri. Sc.*, 1942, **12**, 564. 2. Pruthi, H. S., and Mohan Singh, *Imp. Council of Agr. Res. mise. bull.*, 1943, **57**, 34.

A *GIBBERELLA* BLIGHT OF RYE HITHERTO UNRECORDED FROM INDIA

A SEVERE blight of rye (*Secale sereale* L.) ears was observed for the first time in the Upper Shillong Farm, Assam, in August 1946. The characteristic symptoms are confined to the heads of the host plant. On the heads the

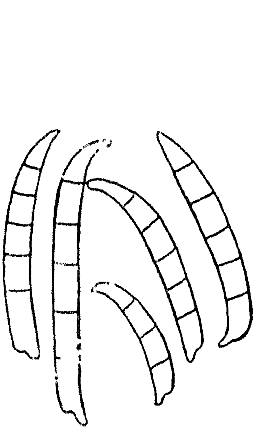
blight may attack at any point, usually affecting and confining itself to only one spikelet, or later spread to other spikelets if conditions are favourable.

The first indication of infection consists of water-soaked areas, slightly brown in colour on the glumes. As the disease progresses the affected areas dry out and take on a ripened appearance. If the infection spreads into the rachis at the base of the spikelet and completely girdles it the portion of the head above this infected region will die and dry up even if it is not directly invaded by the fungus. After a while a cottony fungus growth, slightly pinkish in colour, appears on the dead surface. This growth becomes evident first at the point of infection but later may spread farther over the infected area. Conidia develop on this growth, and with age the pink tint turns to a darker salmon colour. The pinkish conidial masses are more apt to form at the bases of the spikelets where moisture is held for a longer time.

In the blighted heads the grains themselves are frequently invaded resulting in light weight, shrivelled kernels.

The pinkish coating of fungus growth occurring on the surface of diseased parts was found to consist of abundant conidia on microscopic examination. These conidia are long, slender, curved, septate, typical of the genus, *Fusarium*. The spores range in size from $35\text{-}75 \times 4\text{-}5 \cdot 5\,\mu$ with the great majority coming within a size-range of $45\text{-}65 \times 4 \cdot 2\text{-}5 \cdot 5\,\mu$. Most of them are 5-septate with occasional spores having as few as 3 or as many as 6 or 7 septa (Fig. 2).


1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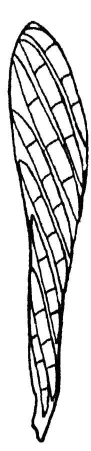
3

FIG. 1. Symptoms of the disease
FIG. 2. Conidia
FIG. 3. Ascus with ascospores

On dead blighted heads the perithecia occur as small, black bodies either singly or in groups. They rest on the surface of the host or may be more or less imbedded in the mycelial crust where conidia have been produced. They are ovoid to subconical in shape and measure $150\text{-}250 \times 100\text{-}250\,\mu$. The asci may number over a hundred to the perithecium and each ascus contains 8 ascospores. The ascospores are fusiform, slightly curved, mostly 3-septate and measure $20\text{-}30 \times 3 \cdot 75\text{-}4 \cdot 25\,\mu$ (Fig. 3).

The fungus was identified as *Gibberella saubinetii* (Mont.) Sacc. This fungus is known to cause scab of cereals in Europe, America, Australia and Great Britain, but so far it had not been known to occur in India. This communication thus records the first report of the occurrence of the fungus in India.

The specimen has been kept in the *Herb. Crypt. Ind. Orient.*, Imperial Agricultural Research Institute, New Delhi, and in the Herbarium of the Plant Pathological Laboratory, Sylhet (S. Chowdhury, No. 237).

Plant Pathological Laboratory,
Sylhet, Assam, S. CHOWDHURY.
March 30, 1947.

INDIA'S VITAMIN WEALTH

INDIA abounds in material that contain various vitamins. One such is Myrobalans (*Emblica officinalis*, "Nellikkai" in Tamil). These fruits contain quantities of vitamin C—a valuable protective food. During the second world war the Nutrition Research Laboratories at Coonoor (South India) were manufacturing tablets from these fruits for the use of the Military. At that time the utilization of these fruits was so much that in certain places there occurred a famine of the local fruit. I have used these tablets with profit. As its need for Military purposes is now non-existent its manufacture has been stopped at Coonoor. Our doctors now prescrbie vitamin C as medicine in the form of very costly imported material like "Redoxon". It is a pity that the utilization of one of our indigenous products has thus come to an abrupt end and to the advantage of foreign manufacturers.

Thyagarayanagar,
Madras, T. S. VENKATRAMAN.
May 6, 1947.

THE DOUBTFUL OCCURRENCE OF A WAX-SPLITTING ENZYME

WHILE fat-splitting enzymes, the lipases, are known from animal, plant and even bacterial sources, wax, on the contrary, is apparently immune to a similar digestion. However there has been a solitary record by Sulc[1] who reports a wax-splitting enzyme in the frothy secretion of a spittle insect, *Aphrophora salicis*. He calls this new enzyme Cerotinase which is suppopsed to give rise to Cerotinic acid. The term Cerotinase gives rise to a confusion with Carotinase, the enzyme which hydrolyses Carotin. Even apart from this the proper designation should be Cerase according to the substrate upon which the enzyme acts, Cera being wax in Latin.

The so-called spittle is usually contaminated with saprophytic micro-organisms, and Sulc tried to get it in as pure a condition as possible. He collected some larvæ of *A. salicis* in their third stage and allowed them to starve overnight. Early next morning they were placed on the branch of a willow tree where they produced sufficient quantity of fresh spittle within the short period of an hour.

A portion of the spittle was used to prove the absence of lipase by the usual technique. Milk, as natural emulsion of fat, was used as substrate; litmus was used as indicator for showing any acidity that may arise on the hydrolysis of butter. Sulc found the spittle naturally alkaline so that litmus became blue and did not need any additional alkalinity which is necessary for the action of lipase. The test for lipase was negative.

For testing Cerase two test tubes were used. One contained the alkaline spittle with litmus, the other had in addition wax as mere chips. The technique was as primitive as it could be imagined, for wax was not offered to the enzyme in the form of a fine emulsion. Nevertheless the action was as rapid as it could be desired, for within 5 to 10 minutes the tube with wax became red. This has been interpreted as due to the action of Cerotinic acid. Now this higher fatty acid is insoluble in water so the explanation cannot hold.

Another weak point in Sulc's paper is the species of insect he studied. He identified it as *A. salicis* from larvæ which can thus leave us in doubt. When we consider the probabilities of meeting with *A. salicis* and *A. alni* those in favour of the latter are far more. In 1910 when Sulc[2] reported on symbiosis in a spittle insect it was *A. alni* and not the rarer species *A. salicis*. In 1912 Buchner[3] illustrated a larva of a spittle insect which I first thought he left unidentified[4] but I have subsequently corrected my mistake as follows. Buchner identifies his specimen as *A. salicis* but it ought to be *A. alni*, being the more common species. In his thesis of 1912 Buchner[3] gives cell inclusions which he repeats in his subsequent studies of 1925, this time rightly identifying the insect as *A. alni* but without correcting his previous mistake; compare his Fig. 6, Plate 11 of 1912 with Fig. 9c on p. 112 of his *Memoir* of 1925. Very probably Sulc also investigated the more common insect *A. alni*.

Since spittle is excreted only by larvæ I wanted to be sure of the species which supplied it. I have previously shown that species can be differentiated by the symbiotes they possess. This has been established in the case of yeast-like micro-organisms. It also applies to the bacterial symbiotes but sometimes cultural methods have to be employed to show the specificity of symbiosis. However *A. salicis* and *A. alni* contain bacteria which differ morphologically, as is being shown in another publication.[5] Having convinced myself of the material I was investigating I tried to repeat Sulc's simple experiments with the spittle from both the insects but with negative results. I also used cultures of symbiotes from these two species and again no Cerase was found.

Sulc also mentions the presence of Cerase in the wax-moth *Galleria melonella*. I had occasion to study enemies of wax-producing coccids and also predaceous caterpillars that feed on the lac insect. I find lac and wax is excreted by these caterpillars and the wax-moth caterpillar feeds on the larvæ of the bee rather than on the wax of the honeycomb. At least this is true of the enemies of the wax coccids.

The existence of Cerase has been implicitly indicated by workers on leprosy. With Chaulmoogra oil injections serum lipase increases and this has been assumed to hydrolyse the waxy lipoid envelope of the leprosy germ. Enzymes are very specific. The increased lipase activity is due to the injection of oil and can be brought about by injecting any oil, be it Chaulmoogra or any other, either in normal subjects or in leprosy patients. Increased lipase activity, contrary to such assumptions, is not indicative of any proper progenesis of the disease.

Biochemical Laboratory,
Research Institute,
Osmania University,
Hyderabad (Dn.),
S. Mahdihassan.
April 4, 1947.

1. Sulc, K., *Zeit. Wiss. Zool.*, 1911, **99**, 183. 2. —, *Sitzb. Bohm. Ges. Wiss. Prag*, 1910. 3. Buchner, P., *Arch. f. Prot.*, 1912, **26.** 4. Mahdihassan, S., *Nature*, 1946, **158**, 58. 5. —, *Proc. Ind. Acad. Sci.*, **B**, 1947, **25**, 155.

THE OCCURRENCE OF TERMITES AT KRUSADAI ISLAND

During a brief stay at the Biological Station at Krusadai Island in the Gulf of Mannar, the author noticed termite tunnels along the woodwork of the windows in the laboratory and collected a number of workers. However, during the few nights spent there, no alate forms were obtained, but a few of these which had fallen previously (probably the day before) into a glass container, were preserved. Dr. Gardner, Forest Entomologist, Dehra Dun, has kindly identified them to belong to *Coptotermes ceylonicus* Holmgren. The material of the tunnel appeared from a microscopic examination as well as by rough chemical tests, to consist of a fairly large percentage of organic material, the rest being chiefly of calcareous matter belonging to the lagoon deposits of the coral island. A cursory examination of the surroundings did not reveal any other indications of the termite nest. Nevertheless the occurrence of the termites arguing the presence of the nest on the island is of considerable interest because of the isolation of the island. As Dr. Gardner observes, it is possible that honeymoon couples may have been borne thither across the arm of the sea from the Pamban mainland by wind currents; nevertheless, their having tended to their first brood, without ready-made workers *in situ*, on the island, is a feature of interest. As those who have been visiting the island from time to time would have noticed, the flora and fauna (especially of the insects) are being added to at a rate which well merits investigation. Further, the invasion, if not deliberate introduction, of insects which can keep the termites in check

must interest the officers in charge of the Biological Station, besides affording scope for experimental studies in control of this pest.

University Zoology Laboratory,
Triplicane, Madras, C. P. GNANAMUTHU.
April 25, 1947.

EFFECT OF DIFFERENT GASES ON PROTOZOAL ACTIVITY AND PURIFICATION OF SEWAGE

FOLLOWING the development of the Activated Sludge Process by Fowler and his associates, there was considerable amount of controversy regarding the actual mechanism of purification. Fowler and his associates emphasised the importance of intensive aeration, but other workers laid stress on mechanical agitation. Some methods of purification have also been developed on the latter principle though they do not altogether exclude the presence of air. The importance of air was finally recognised, and during recent years, the role of protozoa as the organisms mainly responsible for the purification is finding general acceptance.

While investigating the role of different species of protozoa in sewage purification,[1-9] some interesting observations on the effect of different gases on the protozoal activity and attendant changes in the medium were made. The results of one set of experiments with *Epistylis* sp. (one of the most important forms of protozoa in sewage purification) are briefly described below.

Each of a number of conical flasks (250 c.c.) containing 150 c.c. of heat-sterilised sewage was inoculated with 15 c.c. of a fresh culture of the protozoa, washed in ammonia-free distilled water. Nearly equal volumes of air, O_2, CO_2, N_2, the laboratory gas (mixture of kerosene gas and producer gas) and H_2S, were bubbled through the suspensions in the flasks by adjusting the size and number (per second) of the gas bubbles. The progress of purification of the samples was studied by examining at intervals the condition of the protozoa and the sludges as also the quality of the supernatants.

Even during the first two hours of treatment with H_2S, laboratory gas, N_2 and CO_2, the clarification of sewage was adversely affected. These gases being highly injurious to the life and activity of the protozoa, the organisms became inactive and died. The death of the protozoa caused a steady increase in the organic matter content (*i.e.*, the permanganate-reducing capacity) of the supernatants as determined after removal of the gases; this was confirmed by the experiments carried out without the addition of the protozoan inoculum to the sewage.

The observations made six hours after treatment with the gases on the protozoa, and oxidation changes in the sewage samples are given in Table I.

Considerable amount of attention has been devoted to the study of the different methods of applying air to sewage, the aerating value of various gases and the relative importance of oxygen and stirring.[10] The air which is blown into the activated sludge tank has been generally considered to (*a*) keep the sludge in suspension, (*b*) maintain aerobic conditions, and (*c*) stir up the mixture, bringing fresh liquor into contact with the sludge. It has not been possible to say which of these factors determines the critical air requirement. In the light of our observations it appears that the more important function of aeration is the supply of oxygen for the aerobic organisms which bring about the purification of sewage.

TABLE I

Effect of different gases on protozoal activity and oxidation changes in sewage
(Results of chemical analysis expressed as parts per 100,000)

Sewage suspensions* containing the protozoa (*Epistylis* sp.) treated with	6 hours after treatment with the gases: Microscopical observations on the condition of the protozoa	Quality of the supernatants: Appearance	Oxygen absorbed from potassium permanganate in 3 mins.	4 hrs.	Nitrite (N)
1. Air ..	Extremely active	Clear	0·64	1·52	0·040
2. Oxygen ..	"	"	0·56	1·52	0·044
3. Carbon dioxide ..	Inactive or dead	Turbid	1·76	3·40	Nil
4. Nitrogen ..	"	Very turbid	2·68	4·32	"
5. The laboratory gas ..	"	"	3·52	5·56	"
6. Hydrogen sulphide ..	"	Extremely "	—**	—**	"

* The composition of sewage in each case at the start of the experiment was as follows:—
Oxygen absorbed from potassium permanganate in 3 minutes 1·96 (as parts per 100,000)
" " 4 hours 3·28 (" ")
Nitrite (N) .. .. Nil.

** The figures for oxygen absorption in this case were by far the highest.

The authors thank Dr. G. J. Fowler for his valuable criticism.

Dept. of Biochemistry, S. C. PILLAI.
Indian Institute of Science, M. I. GURBAXANI.
Bangalore, V. SUBRAHMANYAN.
March 27, 1947.

1. Pillai, S. C., *Curr. Sci.*, 1941, **10**, 84. 2. —, *Ibid.*, 1942, **11**, 437. 3. —, *Ind. Med. Gaz.*, 1942, **77**, 118. 4. Pillai, S. C. and Subrahmanyan, V., *Nature*, 1942, **150**, 525. 5. —, *Sci. and Cult.*, 1943, **8**, 376. 6. —, *Nature*, 1944, **154**, 179. 7. —, *Sci. and Cult.*, 1945, **11**, 75. 8. —, *Ibid.*, 1946, **11**, 392. 9. Pillai, S. C., Gurbaxani, M. I. and Subrahmanyan, V. *Curr. Sci.*, 1946, **15**, 350. 10. Martin, A. J. 'The Activated Sludge Process', Macdonald and Evans, 1927, pp. 144–148.

CHROMOSOME STUDIES IN THE GENUS *IPOMAEA*

THE genus *Ipomœa* includes several economic plants and many garden favourites. King and Bamford (1927) have published a list of chromosome numbers of several species in this genus. This list does not include some species of *Ipomœa,* for example, *I. pulchella* Roth., *I. carnea* Jacq., *I. reptans* Poir. Kano (1929) has reported the haploid number of *I. batatas* Lamk. as 42 and King and Bamford, however, estimate the diploid number to be 90.

Both mitosis and meiosis were studied. Roots were obtained from the cuttings. All the materials were fixed in CrAF and stained by iron-alum-hæmatoxylin. As the Figs. 1-3 show,

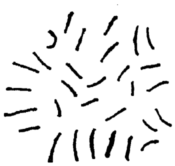

Fig. 1

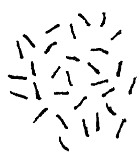

Fig. 2

Fig. 3

Mitotic metaphase plates 1. *I. carnea.* $2n=30$ 2. *I. reptans.* $2n=30$. 3. *I. pulchella.* $2n=30$

I. carnea, I. pulchella, I. reptans have $2n$, 30. The diploid number of *I. batatas* is 90. In *I. batatas* somatic pairing was found among the chromosomes in pairs in majority of plates.

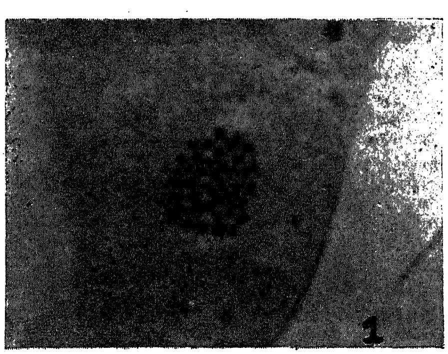

PLATE I.—Meiotic II metaphase in *I. batatas.* $n=45$

In meiosis, stages from diplotene to anaphase were available for study. Fifteen bivalents were formed in both *I. carnea* and *I. pulchella.* The diplotene bivalents showed both terminal and interstitial chiasmata. In *I. carnea,* secondary association among the bivalents was noticed in majority of plates. The haploid number of *I. batatas* was found to be 45. (Plate I).

The plants under study showed some abnormal features. 'Syndiploid' cells or two- to three-nucleate p.m.c. were observed in *I. carnea* and *I. pulchella.* 'Syndiploidy' has been previously reported by several workers in Lactuca (Gates and Rees, 1921), Prunus (Darlington, 1928), Brassica (Karpechenko, 1927). Darlington (1937) considers this phenomenon as a racial or genetic character.

I wish to thank late Dr. V. K. Badami, Ph.D. (Cantab.), for initiating the work, and Mr. S. Sampath for bringing it to completion.

College of Agricultural Research,
Benares Hindu University,
Benares, N. SATYANARAYANA RAO.
March 21, 1947.

1. Darlington, C. D, *J. Genet.*, 1928, **19**, 213–56. 2. —, *Recent Advances in Cytology.* 1937 (2nd Ed.), London. 3. Gates, R. R., and Rees, E. M., *Ann. Bot.*, 1921, **35**, 365–98. 4. Karpechenko, G. D., *Bull. App. Bot.*, 1927, **17**, 305–410. 5. Kano, T., *Pro. Crop. Sci. Soc. Japan*, 1929, **4**, 15–21. 6. King, J. R. and Bamford, R. C., *Jour. Hered.*, 1927, **28**, 279–92.

STUDIES *IN VITRO* OF SOME SULPHANILAMIDE DERIVATIVES

TREFOUEL *et al.*[1] observed that N^4-sulphanilamide acetic acid is a good bacteriostat *in vitro.* In view of this Bami, Iyer, and Guha[2-5] synthesised a number of aliphatic esters and acids substituted at N^4-position of sulphanilamide as well as certain alkylene bis-sulphanilamide and their N^1- and N^4-substituted derivatives.

The bacteriostatic activity of some of these compounds was determined both by the Oxford cup method with staphylococcus aureus and by the turbidimetric method with both saphylococcus aureus and streptococcus hemolyticus.

All the compounds mentioned in the table were soluble in water and had a maximum pH of about 8.

Compounds No. 13 and 14 are a few of the antimalarial drugs of the sulphanilamide-biguanide type while compound No. 15 is a salt of Paludrine.[6]

The table shows that in general the compounds are equally effective against both types of organisms. Compounds No. 1, 11 and 14 however, inhibit streptococcus hemolyticus at a concentration much less than is required for staphylococcus aureus.

Our thanks are due to Prof. P. C. Guha, Dr. K. P. Menon for their kind interest and help during the course of this investigation.

Bacteriostatic activities of some sulphanilamide derivatives

	Compound	Maximum dilution which is active against	
		Staphylococcus aureus	Strepto hemolyticus
1.	Ethylene-bis-N^4—sulphanilamide[2] ..	1·1000	1·5000
2.	Methylene-bis-N^4—sulphanilamide[2] ..	1·2000	1·2000
3.	Trimethylene-bis-N^1—sulphanilamide[2] ..	1·1000	1·1000
4.	Ethylene-bis-N^4—(N^4 heptyl-sulphanilamide)[3] ..	1·1000	1·1000
5.	Ethylene-bis-N^4—(N^1 acetyl-sulphanilamide)[3] ..	1·1000	1·1000
6.	N^4-Sulphanilamido-acetic ester[4] ..	1·1000	1·1000
7.	N^4-Sulphanilamido-acetic acid[1, 4] ..	1·2000	1·2000
8.	N^4-Sulphanilamido-propionic ester[4] ..	1·10000	1·1000
9.	N^4-Sulphanilamido-butyric ester.[4] ..	1·1000	1·1000
10.	N^4-Sulphanilamido-malonic ester[4] ..	1·1000	1·1000
11.	N^4-Sulphanilamido-phenyl acetic ester[4] ..	1·1000	1·5000
12.	N^4-Sulphanilamido-phenyl acetic acid[4] ..	1·1000	1·1000
13.	N^1-p-chlorophenyl-N^5-p-sulphonamido-phenyl biguanide hydrochloride	1·1000	1·1000
14.	N^1-p-chlorophenyl-N^5-p-phenyl sulphonamido-2-thiazole-biguanide hydrochloride	1·1000	1·5000
15.	N^1-p-chlorophneyl-N^5-isopropyl-biguanide acetate (Paludrine)[6] ..	1·1000	1·1000

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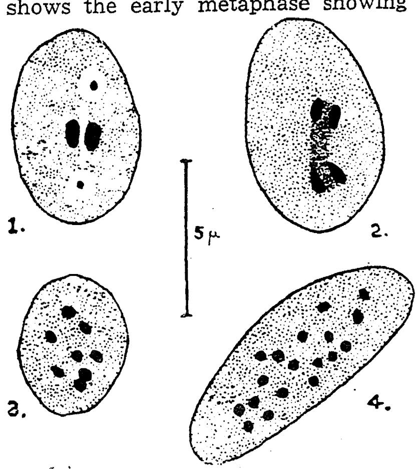
ENDOPOLYPLOIDY IN YEASTS

ARE fermenting cells comparable to actively secreting glandular cells? As far back as 1910, Wager and Peniston[1] suggested such a comparison. And yet, the importance of the above suggestion does not appear to have been realized by later workers. Anyone conversant with the cytology of glandular secretion (Bowen[2]) would be aware that secretory cells take their origin from embryonic replacement cells. Gland cells themselves fall into two distinct categories. In the "holocrine" type, the cells die after a single secretory cycle, while in the "merocrine" type, they pass through several secretory cycles before death supervenes. It has been known for the past one decade that merocrine cells show various degrees of endopolyploidy (White[3]). Some of the remarkable advances in our knowledge of the genetics of Drosophila are based on the study of polytene chromosomes in the endopolyploid nuclei of the salivary gland cells. Resting nuclei of gland cells may or may not show polytene chromosomes. In fact, in many cases their endopolyploid constitution could only be inferred. Cancer cells possess an inherent impulse for rapid multiplication, and it appears that polytene chromosomes could be observed during stages of division (Biesele[4]). Gland cells show only occasional metaphases and the earlier controversy regarding the behaviour of the nucleus in gland cells (Kater[5]) is reminiscent of a similar state of affairs in yeasts (Nagel,[6] Lindegren[7]). To investigate the question whether the failure of gland cells to divide mitotically is the result of their highly endopolyploid constitution Brues and Marble[8] and Biesele[4] studied the cytology of regenerating livers. This was under the belief that partial removal should accelerate mitotic division and bring to light the chromosomes and thus afford evidence regarding the constitution of the nuclei of glandular cells.

If fermenting yeast cells are endopolyploid, then it should be possible to demonstrate the same by experiments planned on similar lines. Just as surgical removal accelerates mitotic division in the liver, replacement of the spent wort with fresh medium in fermenting cultures produces the same effect.

Therefore, tubes of wort were inoculated with the brewery strain *Sc.* 9 and after the lapse of five days the spent medium was poured out and replaced with the same quantity of fresh medium. The contents of the tubes were centrifuged and smeared at five-minute intervals commencing from 40 minutes after the addition of fresh medium. The descriptions are based on Feulgen preparations.[9]

The mitotic cycle during the aerobic phase has already been described for this strain.[10,11] Fig. 1 shows the early metaphase showing the



two chromosomes, the centrioles with their centrospheres and the developing spindle. In Fig. 2 is shown the anaphase.

An examination of the preparations of fermenting cells induced to multiply by addition of fresh medium shows dying cells as well as healthy ones. In healthy cells various division pictures are present. There are rare clusters of cells showing the typical stages seen in the aerobic phase. The majority show varying degrees of polyploidy. In Figs. 2 and 3 two such cells showing different numbers of chromosomes in the cytoplasm are illustrated. The stages of division of such cells are irregular. Often they are abortive. Regular meta- and anaphase stages are rare and the chromosomes generally do not get segregated during division into equal complements. The bud often gets only a much smaller number. There is also a fair percentage of cells showing amitosis-like figures. These are probably the highly endopolyploid cells whose nuclei are unable to resolve themselves completely into their component chromosomes in spite of the very favourable environmental conditions. The stimulus afforded by the nutriment and the availability of dissolved oxygen leads to abortive attempts at division as evidenced by the amitosis-like figures observed.

By their multiplication the embryonic cells in glands replace those that die after a varying number of secretory cycles. It appears likely that a similar state of affairs occurs in fermenting cultures also, where a small percentage seem to retain their power of normal vegetative reproduction (Slator[12]). The products of division of fermenting cells *have no genetical future at all* unless of course a small percentage go through a series of reduction divisions as in the multiple complex cells of Culex (Grell[13]).

Two workers from the same laboratory have recently presented differing interpretations of the structure of the yeast cell (Nagel,[6] Lindegren[7]). While Miss Nagel has found it necessary to coin new terms to denote the various structures in the yeast cell, Lindegren seems to have changed his previous opinion[14] and basing his conclusions on the casual suggestion of Rafalko[15] now believes that yeasts have conventional Feulgen positive chromosomes. He has yet to prove that the homologies of the structures seen by him are identical with those observed by Rafalko.

In view of the varying behaviour of the nuclei during aerobic growth and fermentation, it is not surprising that there is such a remarkable diversity of opinion. In fact one has to expect it. It would be evident that the differing interpretations are not due to the technique of fixation and staining as assumed by Nagel but in the handling of material for cytological investigations. The cytological behaviour of glandular cells in animals are interpreted in terms of changes from normal in response to specialization and no generalization is attempted based on results on glandular cells alone. Yet, generalizations on the nuclear behaviour in yeasts appear to be based on the tacit assumption that there is no difference between a growing culture and a fermenting one. The fact that the yeast is versatile and possesses oxidative and fermentative abilities was forgotten. That the cytology of a dividing cell is entirely different from that of a cell in active secretion was ignored. The tremendous importance of the above distinction can be imagined when it is realized that an actively growing culture would become a fermenting one, when there is not enough dissolved oxygen in the medium for respiration. Once this simple distinction is made, it would be evident that the cytology of yeasts is in no way different from that of higher organisms.

I am very grateful to Sir J. C. Ghosh for his active interest and encouragement and to the Council of the National Institute of Sciences (India) for the award of an Imperial Chemical Industries Research Fellowship.

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AN UNUSUALLY EFFECTIVE CONTROL OF A PEST BY A PARASITE

THE two species of *Epilachna* beetles, *Epilachna dodecastigma* Muls. and *E. vigintioctopunctata* Fab., are serious pests of the brinjal plant in the United Provinces as also in other parts of India. For several years past, the seasonal incidence of these two pests has been under routine observation at Cawnpore, but no sudden changes in their population, as a result of attack by natural enemies, had been noticed. Early in September 1946, however, a heavy parasitisation of the *Epilachna* grubs by *Pleurotropis* sp.* (*Eulophidæ-Chalcidoidea*) was observed in a brinjal field, about half an acre in area at Cawnpore. During the second, third and fourth weeks of September, large numbers of the adult parasites emerged from about 300 *Epilachna* grubs kept in the laboratory for rearing. Simultaneous observations in the field showed that towards the end of the month, practically every grub had been parasitised and the pest brought under complete control. This quick work by *Pleurotropis* sp. against its *Epilachna* hosts is worthy of record. During the period of the field observations, the average maximum and minimum temperatures were 92·7° F. and 77·9° F. respectively and the average relative humidity 84·7 per cent.

The genus *Pleurotropis* has over two dozen species distributed in nearly all parts of the world. The three identified species so far known in India, *viz.*, *P. detrimentosus* Gahan, *P. epilachnæ* Rohwer and *P. foveolatus* Crawford[1], as also some unidentified species, were all reported from Bangalore, Coimbatore or Cochin (South India). The occurrence of a

species of *Pleurotropis* at Cawnpore, therefore, is the first record for Northern India.

While most of the species of *Pleurotropis* have been known to parasitise phytophagous larvae of Coleoptera, Lepidoptera, Diptera and Hymenoptera in various parts of the world several of them have been recorded also as secondary or hyper and even tertiary parasites.[2,3,4] It appears that at least one species, *P. parvulus* Ferr., has been successfully employed in the biological control of pests—in Fiji against *Promecotheca reichei* Baly and in New Guinea against *P. papuana* Csiki, both coconut leaf miners (see *Rev. App. Ent.*, A, 1940, 28 (2), 50-51; 28 (5), 230, and previous connected references).

In view of the fact that the species of *Pleurotropis* have a wide range of hosts and appear to flourish under fairly cold and humid conditions, there is some promise of their being useful against *Epilachna* beetles, damaging brinjal and other cultivated plants in the hills of the United Provinces and other areas.

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* We are thankful to Mr. M. S. Mani, St. John's College, Agra, for the generic identification of this parasite.

THE MODE OF ACTION OF ACETYLCHOLINE ON UNSTRIATED MUSCLE

Singh[1,2,3,4] has suggested that one of the ways in which drugs act is by sensitising the muscle to ions in the solution, the mechanism of this sensitisation being an increase in permeability. This view is supported by the fact, that sometimes unstriated muscle,[5] and striated muscle,[6] do not relax on the withdrawal of the stimulant; the contraction, therefore, must have been caused by some substance, other than the original stimulant.[7]

Action of acetylcholine.—Acetylcholine produces either twitches or tonic contraction in frog muscle. Twitches are produced by small concentrations (1 in 10^5), or at higher temperatures (30° C.). Tonic contractions are produced by large concentrations or at lower temperatures. If acetylcholine produces twitches, then in the presence of subliminal concentrations of substances that usually produce tonic contraction, such as potassium, nitrate, iodide, thiocyanate, it may produce tonic contraction.

The above tonic contraction may be due either to acetylcholine or the contracture-producing substance, one making the muscle sensitive to the other. That it can be due to acetylcholine is shown by the fact that the muscle relaxes on wihdrawal of the drug, though the relaxation may be slow showing that the other substance may also be involved. That it can be due to the other substance, is shown by the fact that the muscle does not relax on withdrawal of acetylcholine, but does so on withdrawal of the contracture-producing substance. Thus if the concentration of potassium in the saline is raised to a value just sufficient to cause a small contraction and acetylcholine added, then, instead of twitches a tonic contraction results. On withdrawal of acetylcholine the muscle does not relax, but does so on withdrawal of potassium (Fig. 1).

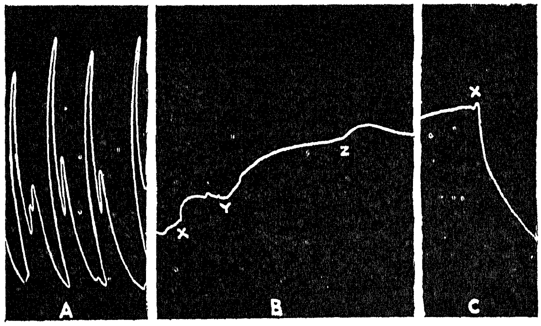

Fig. 1. Frog stomach muscle.
A. Contraction with acetylcholine in saline.
B. Same in the presence of excess of potassium (0·016008 M); potassium added at X, acetylcholine added at Y and withdrawn at Z; no relaxation.
C. Potassium withdrawn at X; note relaxation.

Action of other substances.—In *Mytilus* muscle, similar results are produced if it is immersed in a barium-rich solution just insufficient to cause a contraction. Contraction will now occur if adrenaline or acetylcholine are added, or if electric current is passed, or the muscle is given a sudden stretch or release; this contraction will subside on withdrawal of barium. This shows that electric current, drugs and sudden stretch or release produce some similar effect. This effect is probably responsible for slow relaxation when the muscle is stimulated by contracture-producing substances.

Discussion.—The presence of a substance around the muscle fibres is not sufficient to produce excitation. According to current views, acetylcholine would produce depolarisation of the membrane and so increase the permeability. This would result in entrance of potassium ions into the muscle fibres, so that for excitation, movement of ions appears necessary, as electric current would also produce a movement of ions; this might produce an increase in the concentration of ions in an outer zone.[3]

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REVIEWS

Dating the Past: An Introduction to Geochronology. By Frederick E. Zeuner. (Methuen & Co., Ltd., London), 1946. Pp. viii + 444. Pls. 24 and 103 diagrams. Price 30*sh*.

The term Geochronology was first applied to absolute dating in years, and the author has now extended its definition to include relative dating as well. It covers a wide field, and the very diverse methods of chronology developed by archæologists, stratigraphic geologists, palæontologists, palæobotanists and physicists have been welded together into one connected theme. The book is based on courses of lectures organised by the author as Professor of Environmental Archæology at the University of London, and the major portion of the book has been written with special regard to archæology. The author pleads for a new orientation as to methods in archæology and questions the practice now in vogue, namely, that of using palæolithic implements as zone-fossils. "This practice", he states, "may work well in many cases, but the successes are apt to obscure the fact that the cart is being put before the horse, the precise geological age of the industries being assumed as known (often on very flimsy or even incorrectly interpreted evidence), and this assumption being used to determine the age of the deposit containing the industry". The author, well known for his work on Pleistocene climatology, stresses the need for basing archæological dating on climatic evidences. "I would suggest that the environmental and palæoclimatic aspects of archæological stratigraphy should be granted greater prominence during the excavation. Much has been done in this respect in recent years, but more remains to be done, especially under the supervision of workers trained in this particular line of work."

In Part I of the book, the author gives a comprehensive account of tree-ring analysis which has been successfully applied to the dating of pre-historic sites in America. Summarising the results so far obtained, the author states, "In spite of the limited applicability of tree-ring counting to archæological dating a reliable calendar has been established for the dwelling sites and cultural phases of the south-western United States, covering 1,500 years. This is a spectacular success indeed".

Part II deals with the technique and results of varve-analysis as developed in Sweden by Baron Gerard de Geer and his school. This represents the first method in the absolute chronology of dating in years. Prof. Zeuner thinks that the results are reliable within certain limits, and is sceptical regarding the application of the method in long-distance correlation. A long chapter is devoted to the micro-palæobotanical method of pollen analysis, a technique which in recent years has yielded valuable results and established itself as a reliable method of dating sediments apparently regarded as unfossiliferous.

Part III discusses the climatic chronology of the Pleistocene, the evidence for which is mostly palæobotanical. The chapter is a summary of the author's work on the climatic phases of the Ice-age. Other interesting topics included are: the Astronomical theory of the Ice Age and the chronology of early man and his cultures.

Part IV is a detailed account of the palæontological and radio-active methods of dating the rocks of the earth's crust. There is also an interesting chapter on the time-factor in evolution and one notes the absence of any reference diastrophism as a compelling factor in organic evolution.

The book is a thorough and masterly account of a highly involved subject bristling with apparent anomalies and difficulties of interpretation. The author has made an exhaustive search of literature (as many as 650 references are cited in the bibliographies) and this feature makes it valuable as a source-book. Archæology (particularly in India) has too long been in the hands of workers ignorant of geological methods and concepts, and the present book demonstrates that the chief field of application of geological chronology is pre-historic archæology and human palæontology. 'Dating the past' has been a long neglected branch of geological science in India, and only recently has a full appreciation of its importance as a fundamental research which must precede all economic aspects of geology been realised.

S. R. N. RAO.

A First Course in Mathematical Statistics. By C. E. Weatherburn, M.A., D.Sc., Professor of Mathematics in the University of Western Australia. (Cambridge University Press), 1946. Pp. xv + 271. Price 15*sh*. net.

The present trend in text-book writing in statistics reveals two schools: the first school shuns anything mathematical and gives the statistical tools as so many magic formulæ to be used in specified cases. This is perhaps necessary for the layman or for those applied Statisticians who do not possess the rudiments of mathematics. The other school treats statistics as a branch of mathematics and leaves the physical background untouched. Both schools suffer from the defect that none meets the practical requirements of the applied statisticians. In statistics, as in other applied sciences, the knowledge of the tools are as much necessary as that of the ground on which they will be used. Nevertheless, the theory of tool-making as an abstract science is very useful to those engineers who want to use tools efficiently in their jobs, so knowledge of the mathematical theory of statistics is useful to the statisticians who want to use statistics efficiently in their investigation.

The object and scope of the book is clearly stated by the author in the preface in the fol-

lowing line. "The subject treated in the following pages is best described not as statistical methods but as statistical mathematics or *the Mathematical Foundation of the interpretation of statistical data*." But as this book is aimed to be a first course in Mathematical Statistics, the author confines himself to that portion of the subject as is intelligible to "the students with an average mathematical equipment including an ordinary knowledge of the Integral Calculus."

The content of the book is briefly given as follows. The first chapter gives the fundamental idea of frequency distributions and the concept of moments (including first moment and variance). This is followed in the next chapter by the fundamentals of the theory of probability and probability distributions. Here also are considered the important theorems of Techybecheff and Bernoulli and the concept of convergence in probability. The moment-generating functions (characteristic function) and cumulative functions are also introduced here. The third chapter deals with the important univariate distributions of Bernoulli, Poisson and Gauss-Laplace (normal). The next two chapters develop the theory of Bivariate distributions, theory of regression (linear and curved), normal equations for fitting regression lines, theory of correlation, correlation ratio, intra-class correlation, etc. The idea of sampling and standard errors of statistics in large samples are discussed in the next two chapters (Chapters VI & VII). Before dealing with the theory of small samples and the exact sampling distribution of statistics, the author deals with the general problems of the Beta and Gamma distributions in detail in Chapter VIII. The next two chapters deal with the small sample theory and the uses of the 't' Z (or F) statistics. Their distributions are considered as the applications of the Beta and Gamma distributions. In the eleventh chapter the author considers the problems of Analysis of Variance and Covariance and considers the randomised block and Latin square arrangements, simple factorial arrangement. The tests of significance of coefficients of correlation, coefficient of regression, the correlation ratio, linearity of the regression line, etc., are also considered. The book closes with the XII Chapter where problems of distribution in more than two variates are considered with problems of partial regression, multiple correlation, etc.

The book is quite well written and is fairly complete within the limits set by the author. The book will be useful to beginners as an introduction to the mathematics of statistics, and may serve as a help-book to students appearing in the degree examination in statistics in an Indian University. The total omission of the empirical system of curves such as the Pearsonian system or the Kram-Charliar system is a defect of the book which the reviewer hopes will be removed in the next edition of the book. The elaborate exposition of the moments and cumulants loses much of its usefulness due to this. The knowledge of these curves to the practical and theoretical statistician is essential, and these could have found a place in the book without infringing on the mathematical limits set by the author. We end with an unimportant remark. In page 186, it is stated that the distribution of $t = \frac{(x-\mu)\sqrt{n}}{s}$ was found by W. S. Gosset. But Mr. Gosset found the distribution of a statistic Z (which is $\sqrt{n-1}\,t$) which is slightly different from t. The t was introduced by Prof. Fisher.

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Calculating Machines. By D. R. Hartree. (Cambridge University Press), 1947. Pp. 40. Price 2*sh*.

This booklet is based on the inaugural lecture given by Prof. Hartree after his appointment as the Plummer Professor of Mathematical Physics in the University of Cambridge. The author who had the privilege of handling and working with one of the modern calculating machines set up at the University of Pennsylvania, known as the ENIAC, gives in this little book a brief, critical and authoritative account of the different types of calculating machines and of the ENIAC in particular and points out their limitations and prospective developments.

Equipment for carrying out numerical calculations can be divided into two main classes. They are distinguished by the terms 'analogue' and 'digital' machines. Analogue ones operate by translating numbers into physical quantities of which the numbers are measures and finally measuring some physical quantity to give the result; examples are the slide-rule, planimeter, differential analyser, etc. On the other hand, the digital machines handle numbers directly in digital form usually counting discrete events of some kind; examples are the ordinary Brunsviga and Marchant calculating machines. After referring to the two types of machines described above and to the recent developments, the author points out that digital machines which use the technique of electronic circuits hold out most promise for the future because of their high speed.

The only calculating machine yet completed and operating using electronic circuits as the computing elements is the ENIAC (Electronic Numerical Integrator and Calculator) developed and built by the Moore School of Engineering at the University of Pennsylvania. It is essentially a multi-register machine operating by counting electrical pulses by electronic counting circuits and works directly in the scale of ten to ten figure capacity. The main parts of the machine are accumulators (registers), function tables, card reader, card puncher and master-programmer. The master-programmer is the most important part of the machine through which the repetition of a computing sequence and changes from one computing sequence to another are organised. The ENIAC comprises 18,000 valves and takes a power of 150 kw while in operation. The ENIAC carries out an addition in a fifth of a millisecond and a multiplication in less than three milliseconds. It has a high-speed memory capacity of 20 numbers. This according to the author is the most severe limitation of the ENIAC. In spite of this fact, the speed of operation of the ENIAC is of the order of a thousand times faster than anything else at present available. The power and speed of the

ENIAC could be judged from the fact that non-linear differential equations with two-point boundary conditions are successfully solved in a few minutes.

While pointing out that the use of a machine is no substitute for the thought of organising computations but only for the labour of carrying them out, the author emphasizes the importance of getting the "machine's-eye-view" of the problem to be solved and of giving the machine appropriate instructions. Even if some of the organisation of the calculations is done by the machine, as is possible in future developments, the operator will still have to think out the sequence of operating instructions which will enable the machine to do this organisation. Discussing about prospective developments in the technique of calculating machines, the author says that machines having a high-speed memory capacity of over 1,000 figures and using much less equipment and power than the ENIAC are under development and when completed they will certainly have considerable reactions not only on the strategy of large-scale numerical work but also on the formulation of some classes of problems in mathematical physics.

R. S. K.

Surveying—Theory and Practice. By John Clayton Tracy. (John Wiley & Sons, New York; Chapman & Hall, London), 1947. Pp. xxxiv + 1,279, illustrated. Price $7.50.

This is a revised and greatly enlarged edition of the author's pocket manual, *Plane Surveying*, first published in 1907. The book is divided into four main parts, namely, Field Work, Office Work, Surveying Instruments and Standand Surveys. Each part is again subdivided into several chapters, bearing on individual aspects of survey work.

Every experienced Surveyor will heartily endorse the remarks of the author in the Preface to the book, *viz*., "The theory of Surveying can be learned in College, but the art of Surveying can be acquired only by long experience". This exhaustive treatise will be very useful in assisting the Surveyor to gain such experience in the correct way. Examples of actual detailed surveys carried out in practice are given with exhaustive notes and clear explanations as to the various observations recorded in the Field Book. These impress the reader with the importance of giving attention even to the minutest details in order to make a good job of any survey work carried out in practice.

The chapters on "Methods of Locating Details", "Working up Field Notes Preparatory to Plotting", "Finishing the Map", "Aerial Photographic Surveys", etc., are some examples where details required are elucidated in a simple and clear way. In many instances, the author deals with different methods of conducting any one particular kind of survey. This gives the student the necessary background to choose the appropriate method to be adopted in any particular situation.

The treatise will be very useful as a textbook for students in learning Survey, no less than to practising Surveyors. The 23 tables given at the end of the book and those that are interposed in the body of the book are valuable adjuncts and enhance the value of the volume as a book of reference.

K. B. K. R.

The Chemistry of Acetylenic Compounds—Volume I. The Acetylenic Alcohols. By A. W. Johnson. (Edward Arnold & Co., London), 1946. Pp. xx + 394. 35/- net.

The present volume is a very welcome addition to the literature in organic chemistry. The subject-matter is divided into three parts according to the number of hydroxyl groups and acetylenic bonds contained in the molecule. Each of these parts has again been subdivided into eight sections thereby giving a connected, collected account exhaustively reviewed up to September 1945. Tabulating of the known acetylenic alcohols and their physical constants and the indexing are properly and helpfully done.

The chemistry of compounds containing acetylenic linkages has, until very recently, been considered to be only of academic interest. The rapid development of the chemistry of polyenes has resulted in more attention being paid to acetylenic compounds. A number of improved preparatory methods for the hydrocarbons, carbinols and glycols are now available. A particularly active form of sodamide in liquid ammonia gives a distinct advantage over the old sodamide method since the sodio-compounds undergo smooth substitution reactions. Large-scale production of carbinols and glycols can be effected by employing potassium hydroxide and calcium carbide. The isomerism of acetylenes into allenes and conjugated dienes, and the anionotropic rearrangements of acetylenic carbinols derived from $\alpha\beta$-unsaturated carbonyl compounds are receiving greater attention. Alkylation of phenols using acetylenic compounds has resulted in the fairly ready synthesis of compounds closely allied to natural products. Vitamin E analogues have been synthesised by the condensation of alkylated hydro-quinones containing at least one free position in the nucleus with tertiary acetylenic carbinols. Divinylacetylenes have also been employed for the alkylation of phenols. The chlorination of the hydrocarbons, carbinols and glycols have received attention. The chemistry of the rubenes and their ability to absorb oxygen on irradiation are topics of interest. The application of the reactions of acetylenic carbinols to synthetic problems in the field of the sex hormones has proved to be of fundamental importance. An interesting synthesis of vitamin A methyl ether has been reported whereby the Grignard derivative of ethinylcarbinol of β-ionone is condensed with 1-chloro-2-methyl-4-methoxy-2-butene and the resulting monoether of the acetylenic glycol partially reduced over a palladium catalyst. Rearrangement and dehydration in acetic acid in the presence of a trace of *p*-toluene sulphonic acid gave vitamin A methyl ether.

The reviewer has read the book with interest and profit and feels sure that the volume is indispensable to workers in the field as well as to those who wish to acquire a thorough knowledge of the subject.

K. N. M.

Introduction to Silicate Industries. By H. N. Bose. (Ceramic Publishing House, Church Road, Bhagalpur, India), 1947. Pp. viii + 84. Price Rs. 7-8-0.

The author is already fairly well known for his works on *Modern Pottery Manufacture, Pottery Management* and other technical books. The book under review, as the title indicates, is a broad outline of major industries which utilise silica for their raw material. Thus the manufacture of glass, enamel, pottery, limes, cements and refractories are described in the present volume. Each chapter is logically developed with a brief history, raw materials required, methods and machineries of production and properties of the products. The author has purposely avoided technical language and formulæ in order that the book may be useful for the general reader. The volume is sure to be of interest for non-technical industrialists, parliamentarians, civilians and general science students. The book is well printed and got up, but contains a number of printing errors which could have been avoided. This may be rectified when the next edition is issued. The inclusion of at least a subject index would have added to the usefulness of the book.

K. S. R.

Rothamsted Experimental Station—Report for the War Years 1939-1945.

An impressive document covering about 270 pages represents the consolidated report of the work done at Rothamsted during the War years. The period has witnessed the Centenary Celebrations (1943), expansion of buildings and activities and the inevitable change of personnel. The retirement of Sir John Russell after over thirty years of meritorious service and succession by Dr. W. G. Ogg; the passing away of Messrs. D. W. Cutler and E. H. Richards, both of whom have left their marks on their respective branches; the creation (or reconstitution) of Crop Physiology, Plant Pathology and Plant Biochemistry are noteworthy events of the period. During the War, the Station also accommodated a number of other departments from London and elsewhere, and these, in turn, have left their mark on the work of the laboratories.

The total number of publications during the period runs to some hundreds. Among the contributions, special mention may be made of the discovery of common-salt as a fertiliser for sugar-beet, the increased output of sugar being almost equivalent to the weight of salt applied; the development of silico-phosphates as fertilisers; the demonstration of the value of molybdenum as an important trace element; the study of mutants formed as the result of soil inoculation with soil bacteria; the finding of 2 : 4 dichlorophenoxyacetic acid as a useful weed-killer; extensive work on the nature and properties of plant viruses, their identity as nucleo-proteins, the development of serological methods for their detection and study of inter-relation between vectors and hosts; the comparative studies on pyrethrum extracts and DDT for plant protection; influence of protozoa, by their selective feeding, on the soil bacteria; effect of poison gases on crops, grains and other stored goods; level of feeding dairy cows on milk production; the foul brood disease of bees which has been controlled; and the experiments on deep (7-8") and shallow (3-4") ploughing which have not revealed much difference between the two except in the case of certain crops. Many of the findings are of practical value and may soon lead to extensive application in different parts of the world.

The results with composts and sewage sludges are rather disappointing. The observation that digested sludges form better manures than raw sludges may not be generally accepted. The advantages of composting refuse with activated sludge was demonstrated in India several years ago.

The publication is a remarkable document in that it shows no visible signs of the difficulties and privations of the War years. Some departments have no doubt spent a good deal of time on special War work, but even these are of ultimate scientific and practical value. Certain departments like Plant Pathology and Entomology seem to have carried on as in normal times, while laboratories in distant parts of the world, which did not even see a blackout, were greatly affected by the war. This type of calm, detached and persistent effort reflects much credit both on the station and its workers.

V. SUBRAHMANYAN.

Biochimica et Biophysica Acta *(International Journal of Biochemistry and Biophysics)*, Vol. I. (Inter-Science Publishers Inc., New York), 1947. Annual Subscription $ 9.00.

The publication of international journals in every field of human endeavour is always to be warmly welcomed as one of the effective means for the promotion of international amity and understanding. Pre-war Germany was the pioneer in organising international collaboration in the editing of science journal and the publication of the well-known series of "Hand Buchs". The scene of such activity has now shifted to America which has emerged out of war with enhanced scientific prestige and material resources.

The new Journal covering as it does both Biochemistry and Biophysics is more comprehensive than its contemporaries which specialise in either of the two. The first issue, however, contains papers on Biochemistry only, and covers the fields of Enzymes, proteins and micro-chemical analysis. The papers are presented either in English, French or German, each being followed by a summary in all three languages.

The international representation on the Editorial Board of the Journal could be further reinforced by inviting members from Austrian, German, Asian and Australian countries also. We wish to extend a hearty welcome to the Journal and wish it a progressive and purposeful career. The publishers deserve to be congratulated on their enterprise.

K. S. R.

SCIENCE NOTES AND NEWS

SCIENTIFIC MAN-POWER COMMITTEE

To ensure the proper development and utilisation of India's scientific man-power and resources the Government of India have set up a Scientific Man-Power Committee with the following terms of reference:—

(1) To assess the requirements for different grades of scientific and technical man-power, taking a comprehensive view over a period of the next ten years, of the needs of Government (civil and defence), of teaching and research, and of industry, agriculture, transport, medicine and other fields dependent on the use of scientific and technical man-power.

(2) To make recommendations regarding action to be taken during the next five years to meet these requirements, in particular with reference to:

(*a*) the immediate improvement and expansion of facilities for scientific and technical training in Indian universities and special institutions;

(*b*) training overseas in scientific and technical subjects;

(*c*) the promotion and development of scientific and technical research;

(*d*) the utilisation of scientific and technical man-power; and

(*e*) the maintenance of a register of scientific and technical personnel to facilitate their utilisation to the best advantage.

The future of industry and defence as well as the large number of development plans and projects which have been prepared or are under preparation depend upon the proper and most effective organisation and utilisation of the scientific man-power and resources available in India. The Scientific Man-Power Committee will survey the problem in all its aspects and recommend policies which should govern the use and development of the country's scientific man-power and resources during the next ten years.

DR. RAJENDRA PRASAD'S APPEAL TO SCIENTISTS

The need on the part of scientists to apply themselves first to matters relating the welfare of the common man was stressed by Dr. Rajendra Prasad, Food Member, Government of India, when he addressed the members of the Indian Institute of Science, on the 9th May.

The primary need of the common man as also of everybody was food, and as such, research institutes such as the Indian Institute of Science should first concern themselves with research in food production. It was no good for research workers concentrating themselves in any work if it meant ignoring the needs of their villagers. Their work should have a bearing on the needs of the villagers and they should evolve formulæ by which more and better food would be grown.

INDIAN AGRICULTURAL RESEARCH INSTITUTE

The following students of the Indian Agricultural Research Institute, New Delhi, have been awarded the Diploma of the Institute (Assoc.I.A.R.I.) after completion in September 1946 of two-year P.G. Course:

Agricultural Botany and Plant Breeding

(1) Narendralal Dhawan: "Interspecific hybridization in *Sesamum* L." (2) S. Basharat Ali Shah: "Colchicine-induced polyploidy in different varieties of chillies (*Capsicum annum*)". (3) V. Ramamurthy: "Pt. I.—Studies in the seed-coat anatomy of Brassica species." "Pt. II.—Studies on colchicine-induced polyploidy in some Imperial Pusa types of *Sesamum orientale* L." (4) Choudhry Mohd. Sharif Sardar Khan: "Influence of late sowings of wheat on yield and variation in plant characters". (5) Yogendra Mohan Upadhyaya: "Variability and the role of natural selection in wheat varietal mixtures and hybrid generations". (6) Shyam Narain Sharma: "Effect of temperature on the development of wheat grain".

Agricultural Chemistry and Soil Science

(7) Khubo Gianchand Tejwani: "Effect of nitrogenous and phosphatic fertilizers on soil fertility and crop composition when legumes or either included in or excluded from the rotation (a Lysimeter study)".

Entomology

(8) Parkash Lall Renghen: "Pt. I.—On the morphology of immature stages of fruit-fly *Dacus cucurbitæ* Coq. with short notes on its biology." "Pt. II.—Our present knowledge of the insect pests in India of the important edible fruits of the family Rosaceæ". (9) Abdul Maman: "Pt. I.—The Survey of insect pests of dried fruits". "Pt. II.—Biology of the saw-toothed nuts bettle *Oryzaephilus mercator* Fauvel, with description and bionomics of one new species of the genus *Statimopoda*". "Pt. III.—Thorough review on the work done on most important pests of dried fruits, with a separate chapter on control measures". (10) Mohammed Mohsin: "Pt. I.—Studies on the role of nutrition in the longevity and fecundity of *Microbracon gelectiæ* Astom., a larval parasite of potato tuber moth." "Pt. II. A review of the work done in the control of the sugarcane moth borer, *Diatræa saccharalis* Fab. by its egg parasite, *Trichogramma minutum* Riley."

Mycology and Plant Pathology

(11) Hari Krishna Saksena: "Studies in the physiology of *Ustilago tritici* (Pers.) Rostrup. causing loose smut of wheat".

Sugarcane Breeding

(12) Obaidullah Jan: "Pt. I.—Sugarcane breeding with special reference to the work done in Coimbatore". "Pt. II.—Some studies on the influence of the size of the sugarcane setts, location of nodes and the depth of planting on the germination, tillering and final stand of the crop". (13) Om Prakash Agarwal: "Pt. I.—The activities relating to the production of Co. canes with special references to the breeding work at Coimbatore". "Pt. II.—Studies on the effect of period factor on growth of sugarcane".

FIRST ANNIVERSARY OF THE GEOLOGY DEPARTMENT, PATNA UNIVERSITY

The First Anniversary of the Geology Department, Patna University was celebrated on the 25th April 1947 in the University premises.

In the premises of the University Library, a geological exhibition was held illustrating the Mineral Industry of the Province. It contained most of the industrial minerals and products of Bihar, *e.g.*, iron, coal, copper, aluminium, ceramics, cement, glass, etc.

The function in the evening was presided over by the Hon'ble Acharya Bhadrinath Varma, Minister for Education for Bihar. A popular lecture illustrated with maps and lantern slides was delivered by W. D. West, Director, Geology Survey of India, on Bihar's Mineral Wealth and Industries.

JOINT EXPEDITION TO THE ANTARCTIC

Leading British Scientists have accepted the general plan for the joint Norwegian-British-Swedish Expedition to the Antarctic.

Mr. L. P. Kirwan, Director of the Royal Geographical Society in London, said that though the bulk of the work is going to be done by Norwegians because the expedition was being conducted under the Norwegian Flag, it had been agreed that a Briton would be Deputy Leader to Major-General Hjalmer Larsen, the Norwegian explorer, who has been the main figure in arranging this joint Antarctic trip.

"We have decided to give financial help to this joint expedition and we expect financial help from the British Government", Mr. Kirwan said. "This will match the help from the Norwegian and Swedish Governments, for the expedition is to cost £100,000."

Mr. Kirwan added that one of the two Catalina flying boats which will be used by General Larsen will be manned completely by British personnel.

GOVERNMENT OVERSEAS SCHOLARSHIPS

One hundred and thirty-six candidates have been selected for the Central Government's Overseas Scholarships this year. These include 86 Hindus, 34 Muslims, 2 Scheduled Castes, 6 Christians, 1 Parsi and 7 Sikhs.

The total number of applications received was 2,497 and 293 were interviewed. Most of the successful candidates will go to U.S.A. or the U.K., though a few will go to the Continent and China as well as the British Dominions. The total of subjects for which candidates have been selected is 83.

COCONUT RESEARCH SCHEME, CEYLON

Dr. T. S. Raghavan, formerly Professor of Botany, Annamalai University, has been appointed Botanist to the Coconut Research Scheme, Ceylon, in place of Dr. W. V. D. Pieris. He has published much work in cytology and cytogenetics. Recently he synthesised a new species of Sesamum by hybridisation between *Sesamum orientale* and *S. prostrotum*, the sterile hybrid having been artificially rendered fertile through the induction of amphidiploidy. In the hybrid has been incorporated the perennial habit of the prostratum parent.

INDIAN SCIENTISTS TO VISIT BRITAIN

SIR SHANTI SWARUP BHATNAGAR will leave for the United Kingdom in the first week of July to attend the Centenary celebrations of the Chemical Society, London, and the International Congress of Pure and Applied Chemistry, London, to be held in July. Three other Indian scientists—SIR J. C. GHOSH, SIR C. V. RAMAN and SIR K. S. KRISHNAN—are also expected to attend the Centenary celebrations.

Sir Shanti Swarup intends to visit Germany and Switzerland also.

PLAN TO CONSERVE COAL RESOURCES

With a view to drawing up a ten-year programme for conservation of coal resources through scientific process of coal stowing, the Government of India in the Works, Mines and Power Department, have decided to appoint a Committee of Experts consisting of Mr. J. R. Harris, Coal Commissioner, Mr. Nausher Ali, Chairman, Coal Mines Stowing Board, one nominee of the Railway Board having experience in railway transport problems, and the Chief Inspector of Mines.

SOLAR ECLIPSE

On 20th May 1947 scientists studied the total eclipse of the sun at Bocaiuva in Brazil. Many other points on the sun's path, close to this village, were chosen by various expeditions from all over the world.

Various projects had been planned for this eclipse including the testing of new, high-powered photographic instruments as well as scientific confirmation of existing theories of light, magnetism, colour and space. Einstein's relativity theory was studied by several Geophysicists. Brazil's National Observatory which had also organised an expedition in the field and another in the observatory hundreds of miles away from Rio de Janeiro, compared observations from the sun's path and from a varying angle.

Interesting results are expected from these investigations.

WORLD STATISTICAL CONFERENCE

The United States have invited 62 Governments to send delegates to the International Statistical Institute, and the 21 American Republics to send delegates to the first session of the Inter-American Statistical Institute.

These organisations will meet in September. The World Statistical Congress, which is being convened by the U.N. Economic and Social Council, will also meet in Washington at the same time.

The International Statistical Institute has held biennial sessions for more than 60 years at the invitation of various Governments. President Truman, as chief executive of the host nation, has accepted the Honorary Chairmanship of this session.

COONOOR PASTEUR INSTITUTE

Dr. N. Veeraraghavan has been appointed to officiate as Director of the Pasteur Institute, Coonoor, in place of Lt.-Col. Ahuja who is transferred to Kasauli as Director of the Central Research Institute.

INDIAN INSTITUTE OF SCIENCE

Mr. M. S. Thacker of Calcutta has been appointed the Head of the Power Engineering Department of the Indian Institute of Science.

UNIVERSITY OF MADRAS

The Registrar invites applications for the post of a Lecturer in Leather Technology on Rs. 210-15-300 *plus* D.A.; and a Lecturer in Textiles on Rs. 210-15-300 *plus* D.A., before the 25th of June 1947. Further particulars can be had from the Registrar.

AQUARIUM FOR BOMBAY

Mr. B. G. Kher, Premier of Bombay, laid the Foundation Stone of the "Taraporevala Aquarium" in Bombay on the 9th May. Mr. D. B. Vicaji Taraporevala, after whom the Aquarium is named, donated a sum of Rs. 2,00,000 while the Government of Bombay has contributed Rs. 5,00,000 to meet the cost for the construction.

PHARMACEUTICAL COLLEGE FOR BOMBAY

A sum of three lakhs and one thousand rupees has been donated to the Ahmedabad Education Society for starting a Pharmaceutical College in memory of the late SETH LALLUBHAI MOTILAL.

The Governing Body of the Society has decided to name the College which will be the first of its kind in Bombay Province after SETH LALLUBHAI MOTILAL.

RHODES SCHOLARSHIPS FOR INDIA

Mr. Asim Kumar Datta of Bengal and Mr. Lovraj Kumar of the United Provinces were elected by the Rhodes Trustees to the two Rhodes Scholarships that were allotted to India for the first time last year. Two more of these scholarships have now been advertised in the Press by the Selection Committee for India, presided over by Sir Maurice Gwyer, Vice-Chancellor of the University of Delhi. The scholarships tenable at the University of Oxford, for two, or in certain circumstances three, years are of the annual value of £400 with, subject to certain conditions, a supplementary allowance of £100 per annum.

DEVELOPMENT OF FISHERIES

Dr. Rajendra Prasad, Food Member, Interim Government, laid the Foundation Stone this morning (13th May 1947) of the Hydro-Biological Laboratories at "Fish-lands", Chetput, Madras.

A "Mermaid Fair" had been organised to demonstrate the importance of fish as food and the various experiments that were being carried on by the Fisheries Department. Several stalls had been put up. Fish of various kinds found in the Province, and charts showing their food-value were also exhibited.

THE INTERNATIONAL UNION OF BIOLOGICAL SCIENCES

The International Union of Biological Sciences (sec M. J. Sirks, University of Groningen) will hold its 9th Assembly in Copenhagen, on July 28, 1947. The meeting will be chiefly concerned with establishing a programme of work for the Union and its Sections for the period 1947-50. The Union will be in a position to arrange, in the near future, for *special conferences (limited to ten invited scientists) on timely subjects* and Dr. Sirks will welcome suggestions from delegates and other colleagues for such conferences.

THE FIFTH INTERNATIONAL GRASSLAND CONGRESS

(*Secretary*, C. K. Van Daalen, Bilthoven, Neth.)

The Fifth International Grassland Congress which will be held in the Netherlands, June-July 1949, will be concerned chiefly with grassland problems of regions with a temperate climate. Excursions will be made through the various pasture types represented in the Netherlands. There will be five sections: (1) Soils, Manuring; (2) Genetics, Breeding, Seed prod.; (3) Grassland sociology and ecology, Botanical analyses of grassland; (4) Making, management and utilisation of grassland, Farm organisation questions; (5) Fodder values of pastures, Fodder conservation.

DEVELOPMENT OF MINERALS

An administrative organisation to standardise conditions of mineral development in India and also to exercise Central control over the exploitation of the country's mineral assets will soon be set up by the Government of India.

This organisation, to be known as the Bureau of Mines, will function under the aegis of the Member for Works, Mines and Power of the Government of India.

The scope of this central organisation will *include powers to frame rules regarding* the terms and conditions of leases, the application of improved mining methods to ensure conservation of mineral assets, control over exports, collection and compilation of statistical returns, encouragement of the domestic utilisation of ores and minerals, and the prosecution of research on mining and fuel.

The Central Government, it is gathered, have decided to form this organisation with a view to formulating a policy of co-ordinated development, conservation and consolidation of India's mineral wealth as well as to provide an effective check to unrestricted exploitation. This Bureau will not only further mineral development within the sphere allotted, but will also assist Provincial and State Governments in such schemes as they might sponsor for the development of their mineral resources.

A well-organised laboratory with the latest and most up-to-date equipment will be attached to this Bureau for fundamental and applied research in mineral development, etc., and other necessary purposes. A department of Public Relations will form part of this organisation, to acquaint the general public with the details of mineral research undertaken by the Bureau.

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// CURRENT SCIENCE

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TECHNICAL EDUCATION IN INDIA*

THE role of science in modern world is rather confused. On the one hand, science has evolved atomic power, shining malevolently in its crown, and, on the other, dialectically enough, it has great and lasting achievements in the service of humanity and the development of the arts of peace. For example, in the last Great War science has been utilised to an extent which staggers human imagination in perfecting the weapons of death and destruction. At the same time, it has also made, in the midst of the war, great and valuable contribution in alleviating the miseries of mankind. To give but one example: Medical Science during the War was so fully developed that it was responsible for bringing the Army's death rate from 14·1 per thousand in the last War to 0·6 in this. These are two contradictory manifestations of science which have puzzled men in every generation and clime. The question that naturally arises is, how in the midst of these conflicting ends Science can make its maximum contributions to the welfare of Society. This is impossible without a re-definition of the role of Science in Society. True Science has little to do with war. The problem is how to break the periodic and death-dealing subversion of Science to war, how to shape the superb instrument, built up out of the finest creative ability of mankind, to the conscious ends of peace.

One way of doing it is to harness the power of science to the material development of nations and thereby raise the standard of living of the people to a much higher level than now. Such development should not be restricted to a few countries, as at present, but should be diffused all over the world. In particular, conditions of living should have to be upgraded beyond recognition among the undeveloped countries, like India and China, which between them contain about half of the world's population. The *sine qua non* of such development is the existence of a large body of specialised knowledge and technical skill. In helping to spread such knowledge and skill among the under-developed countries of the world we would be enabling science to play its beneficent role as opposed to the destructive one which it has so unfortunately played with a periodic repetition.

That the creation of a body of technicians may well be regarded as a condition precedent to swift and rapid economic development is

* Text of an Address by Sir N. N. Sarkar, Chairman of the All-India Council for Technical Education. Delivered at the Council at Bangalore on 20th May 1947.

amply borne out by the history of those countries which have reached a commanding position in the sphere of economic development.

The system of technical education even in Great Britain is being reorganised according to the recommendations of the Percy Committee which expressed the apprehension that the position of Great Britain as a leading industrial nation was being seriously endangered by failure to secure the fullest possible application of science to industry.

Soviet Russia offers an illuminating example of what a nation can achieve in the sphere of economic development by stimulating scientific research and technical education. The implementation of a technical personnel plan was an integral part of the economic plan and was carried on simultaneously with the other parts of the plan, as would be evident from a few figures I am citing presently. At the inception of the first five-year plan the Soviet industry as a whole had at its disposal a staff of technical personnel numbering 58,000. The figure was continuously raised under the successive five-year plans until in 1939 it reached the impressive figure of 9,590,000 out of a total population of 170,000,000.

America and Japan have similarly expanded their technical personnel during the last two or three decades.

Indian scientists have no doubt made brilliant original contributions in a number of branches and achieved world-wide renown. The names of Raman and Bose are outstanding in the older generation, but they have also an ever-increasing number of successors in our own times. The results of their research have also been of considerable aid to Indian industries. Nevertheless, it remains true that these researches have not been fully and properly correlated to the needs of industries due mainly to the deficiency of facilities for technical education in our country. This was fortunately realised by the Government of India in recent years which held the view that the most serious bottleneck to the implementation of a plan of economic development would be the inadequacy of technical personnel, and not finance as is usually believed. This awareness on the part of the Government, of which Sir Ardeshir Dalal was the Planning and Re-Construction Member at the time, led to the formation of an *ad hoc* Committee, consisting of scientists and businessmen, with a view to planning for higher technical education facilities in India. The Comittee submitted their interim report recommending the establishment of not less than four Higher Technical Institutions in different parts of India which would serve as models for scientific and technical education, particularly of a very high order. Of them one will be in the North, one in the East, one in the South and one in the West. The Eastern Institute was to be set up first, in or near Calcutta, while the establishment of the Western Institute, in or near Bombay, should be taken in hand concurrently or failing that as soon after as possible. Calcutta and Bombay were suggested for the location of the Eastern and Western Institutes respectively because of the existence of big industries in these areas. In the meanwhile, the All-India Council for Technical Education was set up by the Government of India with three primary objects in view, *viz.*, (1) to survey the whole field of technical education in India, (2) to consider the desirability of establishing high-grade technical institutions on the lines of the M.I.T., and (3) to promote inter-provincial co-ordination in All-India schemes of technical education. The All-India Council endorsed the recommendation of the *ad hoc* Committee, and the Government also, it is understood, has accepted this recommendation. With a view to achieving co-ordination the Council has also set up six All-India Boards of Technical Studies in Engineering and Technological subjects. These Boards, consisting of experts drawn from all over India, are engaged in drawing up syllabuses of studies and evolving sound methods of teaching and examination.

While recommending the establishment of a few high-grade technical institutions the Council at one stage of its deliberations was confronted with a somewhat different view regarding the advisability of establishing immediately such technical institutions. This view, quite good as it is, states that facilities for technical education should be improved and extended by strengthening the existing institutions and that no new institute should be established without first conducting and completing a detailed survey to ascertain precisely the needs and requirements of industries. As regards the first, I may mention that the question of strengthening the existing technical institutions is bound to engage the serious attention of the Council. The existing basis must receive all the care and attention it deserves, since they are as yet the only means to meet the current demands for technical personnel. As we all know, visiting Committees were appointed by this Council for important technical institutions of every region

with a view to determining the facilities available in these institutions, to ascertain their needs and bring the systems of training to a certain standard. These Committees have submitted their reports and these will be considered at this meeting of the Council, whereupon adequate grants will be recommended by the Council to the Government for distribution among these institutes.

On the question of making a detailed survey with a view to determining the needs of industries, there can, of course, be little controversy. If schemes of extending technical facilities are undertaken without regard to actual needs, facilities may be far in excess of needs and, it is contended, the recruits annually turned out may fail to be absorbed in gainful occupations for lack of commensurate expansion of industries. All this is no doubt true; but when the detailed and comprehensive survey of a vast country must necessarily take some time to be completed, this should not be allowed to prevent a beginning to be made in the direction of providing such facilities. Taking, for example, the case of India it can be pointed out that facilities for technical education in this country are so meagre and insufficient to meet even the existing demands that the establishment of a few technical institutions before the survey is completed can never be regarded as leading to a surfeit of such facilities. The plans of hydroelectric development, road-building projects, irrigation and agricultural improvements and various other plans lying ready in the archives of the Governments, both Central and Provincial, would require a large body of technicians. It has been estimated by a British Engineering Journal that the schemes of water-power development alone would need 20,000 technicians. These are only the needs of Governments in some of their departments. There is also the growing volume of requirements of private industries to be satisfied. All these would clearly show that the establishment of a few technical institutions immediately, as recommended by the Council, can by no means be regarded as creating a condition in which the annual number of recruits trained by these institutes exceeds the annual intake of industries, even as we can visualise the latter's needs in a rough and ready manner. Further, in a matter which concerns the education and training of individual human beings, adjustments of supply and demand should be made within wide tolerances. While it may be feared that the creation of new technical facilities may lead to unemployment if they are in excess of existing needs, it is equally plausible to argue that in the case of a growing and newly-developing country the presence of these technicians may act as a spur to development, thereby creating their own conditions of work and employment. In the present condition of India, of course, there can be no question of the supply of technicians outrunning demand. In the future scheme of things also the status of technical and managerial personnel will arise, as finance loses some of its dominating role.

I may here refer to a prevailing notion about the import of foreign technical skill and industrial "Know-how" from abroad to meet India's demands. We shall, no doubt, have to depend on foreign assistance in many spheres at the initial stage, since we have at present very little technical force of our own. But the possibility of any large-scale import of foreign technical experts must be ruled out at present, and this for two reasons. In the first place, there are the calls of reconstruction in Europe and elsewhere, and the enormous industrial and governmental undertakings contemplated in Europe and America to provide full employment. Already a shortage is being felt in these countries of high-grade technical personnel and efforts are being made to meet these shortages. It would be difficult, if not impossible, in these conditions, to secure the services of technical prsonnel from abroad to the extent required by India. Further, whatever services may be available, a tendency has been recently at work for foreign technical experts to demand, apart from extortionate prices, a controlling influence in the concerns for which their services are required. This is all the more reason why India should build up her own higher technical force with the greatest possible expedition.

THE EDITOR, CURRENT SCIENCE

MR. M. SREENIVASAYA, Editor, *Current Science*, left India on the 26th June for an extensive tour of Europe and America. In the course of his tour he will attend the Science Conferences in Sweden, visit important research laboratories, industrial plants and academic institutions. He also proposes to renew and make fresh contacts with the editors and sponsors of scientific journals in the countries of his visit. During his absence from India Mr. K. S. Rangappa, Assistant Secretary, will look after the duties of *Current Science*.

PRINCIPLES FOR THE CONTROL OF PUBLIC UTILITY ELECTRICITY SUPPLY FINANCE*

THE Advisory Board was constituted by the Government of India to examine the principles for the control of Public Utility Electricity Supply Finance, formulated by the Electrical Commissioner with the Government as to which of them should be adopted and to what extent and in what manner they should be enforced. The principles are to constitute the sixth schedule of the Electricity (Supply) Bill, 1946, and are to be incorporated as an amendment to the Indian Electricity Act, 1910.

The Advisory Board consisted of Mr. H. M. Mathews, Electrical Commissioner with the Government of India (Chairman); Mr. D. L. Mazumdar, Joint Secretary to the Government of India, Department of Works, Mines and Power; Mr. P. B. Advani, Special Officer (Electric Grid), Bombay; Mr. K. V. Karantha, Chief Electrical Inspector to the Government of Madras, and Mr. I. A. Macpherson, nominated by the Federation of Electricity Undertakings in India. The report of the Advisory Board was unanimous in every respect except for a note of dissent by Mr. Macpherson regarding "Standard Rate", mention of which is made in the relevant place.

2. The need for an effective and uniform method of control of Public Utility Electric Supply finance has been keenly felt, owing to the fact that under the existing conditions there are a number of factors which retard the development of the electric supply industry in India. The chief of them are: (*i*) A large number of small undertakings, the issued Capital of which is under Rs. 5 lakhs, exist, and their development has undoubtedly been impeded by difficulties experienced in raising capital and the high rate of interest demanded for its provision. (*ii*) The monopolistic character of such undertakings has led to many abuses in the absence of an adequate control. (*iii*) The amount of financial control which a Provincial Government can exercise under the Indian Electricity Act (1910) is inadequate. (*iv*) The interests of the consumer often take a second place to those of the shareholder.

The principles were, therefore, devised so as to fulfil the following objects:

(*a*) To safeguard the interests of the consumer by limiting interest and dividends payable to shareholders to the minimum necessary to ensure an adequate flow of development capital, and thus effect a reduction in the selling price of electricity.

(*b*) To safeguard the interests of investors (and, in the long run, of the consumers as well) by insistence on a properly devised system of compulsory depreciation and at the same time permit the earning of a "reasonable" or "fair" return on the investment.

(*c*) To regulate the commission and expenses of Managing Agents within reasonable limits having regard to the special circumstances of the industry.

* A Note on the Report of the Advisory Board on the Principles for the Control of Public Utility Electricity Supply Finance.

The salient features of the principles are as follows:—

Capital Base

Under these principles the amount allowable as divisible profits will mainly depend on the size of the undertakings' "Capital Base" which is defined as "the depreciated cost of fixed and intangible assets plus working capital but exclusive of goodwill and non-compulsory investments, Debenture and Preference Capital". The Capital Base recommended will permit the various undertakings, who have indulged in the past in the capitalisation of revenue partly at the consumer's expense, to retain the assets thus acquired in the Capital Base. Once the Principles are enforced, however, this practice will automatically cease and when new development capital is required, instead of employing surplus profits, etc., it will be necessary for the undertakings to raise fresh capital from the Public or borrow from other sources.

The relation which the "Capital Base" will bear to the paid-up ordinary share capital will depend on several factors. The "Capital Base" may be greater than the paid-up ordinary share capital in the case of undertakings which have not been prevented from earning an unduly high profit and have been able to capitalize part of this; and conversely may be less for the reason, *e.g.*, the profit and development of the undertaking may have been restricted. The amount in the "Capital Base" represented by the "ploughing back" of undistributed profits prior to the introduction of the principles will signify less and less, and as time goes on, because the tendency will be for the "Capital Base" to approximate more and more to the paid-up ordinary share capital, any excess in the long run being represented by the effects of efficient management.

Standard Rate

3. The "yard-stick" which is used to measure what is considered to be a "Reasonable Return" on the "Capital Base" is the "*Standard Rate*" and the "Standard Rate" is taken to be— in respect of any accounting year the redemption yield of the longest dated terminable loan of the Central Government last issued prior to the last accounting year of the licensee, adjusted to the nearest one-quarter of one per cent., as declared for this purpose at the end of the Government financial year by the Reserve Bank of India to the Central and Provincial Governments, plus

(*i*) 3·5 per cent. for the first Rs. 10 lakhs of the Capital Base;

(*ii*) 3·0 per cent. for the next Rs. 40 lakhs of the Capital Base; and

(*iii*) 2·5 per cent. for the balance of the Capital Base.

4. [Mr. Macpherson recommended in his note of dissent that (*i*), (*ii*) and (*iii*) should be 5·5 per cent., 5 per cent. and 4·5 per cent. respectively.]

"Reasonable Return"

is taken to be—

In respect of any accounting year, the sum of:

(*a*) The amount arrived at by applying the standard rate to the Capital Base at the end of that year;

(b) the income derived from investments other than Contingencies Reserve invested in Trustee securities as defined in the Indian Trust Act; and

(c) half the difference between the interest payable on debenture capital and such greater amount as would have been payable had the money been borrowed at the "Standard Rate".

An important object of the principles is that the excess of the gross income over allowed expenditure, *viz.*, clear profits, shall not exceed the amount of the Reasonable Return. In view of the fact, however, that it may not always be possible for an undertaking to regulate its financial policy in such a manner that the clear profit does not exceed the reasonable return, when such an excess occurs, it is considered that it should to some extent at least be used to supplement the income of the undertaking in the years when the actual "clear profit" falls below the amount of the reasonable return. With this object in view it is proposed in the principles to create a reserve called Tariffs and Dividends Control Reserve. In those years when the undertakings' clear profit is in excess of the Reasonable Return, one-third of such excess shall be credited to this reserve and those years when the undertakings' clear profit is less than the reasonable return, the undertaking may draw from this reserve to make up their deficiency in whole or in part. It has also been provided for that one-third of the excess shall be used for a rebate to the consumers and the remaining one-third be made available to the undertaking as a bonus for efficient operation. Provision has also been made to prevent undertakings from earning a clear profit constantly in excess of the Reasonable Return permitted, by the provision for a Committee which may be appointed by the Provincial Government to examine the licensee's charges for electricity in accordance with the principles.

Remuneration of Managing Agents

The remuneration drawn by the Managing Agent covers two separate items; firstly, commission and secondly, an allowance on account of office expenditure.

Commission.—Under the Principles the commission is based on "Clear Profit" instead of "Net Profit" and shall not exceed without the permission of the Provincial Government.

In respect of the first Rs. 5 lakhs of such profit—10 per cent.

In respect of all additional profit—7 per cent.

In view of the fact that in the early years of working, the clear profit of an undertaking may be small and inadequate to provide reasonable remuneration for the Managing Agents, provision has been made for the payment of a minimum amount as Managing Agent's commission based on the total issued capital.

In the absence of or inadequacy of profits the amount paid to a Managing Agent shall be subject to a minimum payment not exceeding two rupees per annum for each complete thousand rupees of paid-up share and debenture capital, provided that for purposes of computing the minimum payment, should the share and debenture capital be less than Rs. 5 lakhs, it shall be taken as Rs. 5 lakhs and should the said capital be greater than Rs. 1 crore it shall be taken as only Rs. 1 crore.

Office Allowance.—An office allowance drawn by a Managing Agent which includes the salaries and wages of all personnel employed in the office of the Managing Agents with the exception of Engineering staff employed for the purposes of the undertaking is based upon a percentage of the operating expenditure during the year of account on capital works. The office allowance so drawn shall not exceed without the permission of the Provincial Government.

(i) In respect of the first Rs. 1 lakh of operating expenditure—8 per cent.
In respect of the next Rs. 2 lakhs of the operating expenditure—5 per cent.
In respect of the next Rs. 7 lakhs of operating expenditure—2½ per cent.
In respect of all additional expenditure—1½ per cent.

(ii) In respect of the first Rs. 1 lakh of capital expenditure incurred during the year of account—4 per cent.
In respect of the next Rs. 2 lakhs of capital expenditure incurred during the year of account—3 per cent.
In respect of the next Rs. 7 lakhs of capital expenditure incurred during the year of account—1½ per cent.
In respect of all additional capital expenditure incurred during the year of account—1 per cent.

As regards the proper application of the provisions of these principles it is stated that the Provincial Governments even now have the authority necessary to effect the required measure of general control, and when statutory electricity supply Boards are set up under the provisions of the proposed Electricity (Supply) Bill they will have the power to effect an adequate and detailed supervision of the accounts of the licensees under their jurisdiction.

For the industrial and agricultural development of the country an abundant supply of electricity at reasonable rates is the first essential; and in the post-war era the cost of electricity will be of great significance in the establishment of efficient and competitive industry. The enormous profits which the shareholders would have enjoyed will be divided, under the principles, between them and the consumers by way of reduced charges. It may be argued that with reduced charges demand will increase, which the licensee may not be able to cope up with the existing plant. This will result in expansion of the industry with a real "Capital Base" and not an artificial inflated one. The principles are not meant to restrict the sale of electricity but the profit on that sale. It can, therefore, confidently be stated that the Principles, by providing an effective and uniform method of control, would contribute in no small measure to the rapid development of the Electric Supply Industry in India.

H. N. Ramachandra Rao.

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THE EFFECT OF SODIUM CHLORIDE IN IMPROVING THE PERMEABILITY OF ALKALI SOILS

By L. A. Ramdas and A. K. Mallik
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The ascent of an aqueous solution of sodium cabonate through a column of black cotton soil has recently been discussed.[1-4] It was shown that the capillary rise with a *very dilute* solution of sodium carbonate is slightly greater than with water, and as the concentration rose the permeability rapidly deteriorated. But when the concentration was further increased (say, 5% to saturation) the permeability was restored owing to the chemical action of the sodium carbonate solution on the colloidal fraction of the soil. These results have been discussed in the *Proceedings of the Indian Academy of Sciences* (Vol. 25, Pt. 6—in Press).

In the present note we shall discuss some interesting results obtained recently on the effect of *sodium chloride* in restoring the permeability of a column of black cotton soil previously rendered impervious with sodium carbonate solution. The upward and downward movements of *sodium chloride* solution in the "Bari" (alkali) soil of the Punjab are also discussed.

I. Experiments with the Black Cotton Soil of Poona

(*a*) *Capillary rise.*—Glass tubes containing air-dry black cotton soil of Poona, passed through a 1 mm. sieve, were dipped in 1 per cent. solution of sodium carbonate till the capillary rise of the solution stopped (*i.e.*, the height of the soil column visibly wetted by the solution ceased to increase further). The tubes were then dipped up to the level already wetted by the sodium carbonate solution in reservoirs containing (1) a 1 per cent. solution of sodium carbonate, (2) a 5 per cent. solution of sodium chloride and (3) water, respectively.

Table I gives the ascent of the two solutions and water through the columns. It will be seen from Table I that the ascent of a 5 per cent. solution of sodium chloride is about four times that of sodiun carbonate and twice that of water.

In the next experiment the ability of sodium chloride to improve the permeability of the soil after carbonate treatment was further examined.

(*b*) *Percolation through soil layers.*—In this experiment the percolation of the three liquids was studied by maintaining 10 cm. layers of the liquids in different tubes containing the soil. First, 10 cm. layers of black cotton soil were packed in three tubes in the usual manner and 1 per cent. solution of sodium carbonate added above the soil column. After seeing that there was hardly any percolation of the sodium carbonate solution even after two days, the solution was removed from two of the tubes and replaced with the same volume of a 5 per cent. solution of sodium chloride in one tube and with water in another, while the third tube served as control.

Table I

Capillary ascent in black cotton soil (in cm.)

Time (Days)	First dipped in 1% sodium carbonate solution		
1	3·3	3·3	3·3
2	4·3	4·2	4·3
3	4·3	4·3	4·3
	then dipped in		
	Sodium carbonate 1%	Sodium chloride 5%	Water
1	0·6	0·9	0·9
2	1·1	1·8	1·5
3	1·5	2·8	1·9
4	1·7	3·6	2·3
5	2·0	4·3	2·5
6	2·2	4·9	2·8
8	2·6	6·1	3·4
10	2·8	7·0	3·7
12	2·9	7·6	3·9
14	2·9	8·1	4·1

The values for percolation are given in Table 2.

Table 2

Percolation in c.cs. through 10 cm. column of Poona soil

Time (Days)	10 cm. column of 1% sodium carbonate		
1	0·0	0·0	0·0
2	0·1	0·1	0·1
	1% sodium carbonate	Solution replaced by 5% sodium chloride	Solution replaced by water
1	2·5	4·0	2·5
2	3·0	14·0	3·5
4	3·0	39·0	4·0
6	4·0	89·0	5·0

It is obvious from Table 2 that sodium chloride restores the permeability of the black cotton soil, previously rendered impervious by sodium carbonate.

II. EXPERIMENT WITH "BARI" (ALKALI) SOIL OF THE PUNJAB

Next a naturally alkaline soil like the "Bari" soil of the Punjab was similarly tried. This soil is very impervious to water due to the presence of considerable quantities of sodium carbonate and sodium sulphate. Experience showed that care is necessary in packing the "Bari" soil so that breaks in the column do not occur on wetting. This is ensured by loosely packing the soil in the tubes. Tables 3 and 4 give the values for capillary rise in and percolation through the "Bari" soil.

TABLE 3

Capillary rise in "Bari" soil (in cms.)

Time (Hours)	Water	5% Sodium chloride
1	2·4	8·2
2	3·4	14·0
3	4·0	17·2
4	4·4	21·2
22	10·3	46·7
28	11·2	51·3
48	12·7	61·0

It is clear from Tables 3 and 4 that the movement of a 5 per cent. solution of sodium chloride is much faster than that of water in the "Bari" soil.

TABLE 4

Percolation in c.cs. through a 10 cm. column of "Bari" soil

Time (Hours)	Water	5% sodium chloride
1	0	0
2	0	1·0
3	0	3·0
21	0	16·5
27	0·5	21·0
48	1·0	48·0
71	2·5	74·5
96	3·0	121·5

The applications of the above findings to the leaching out of the salts from alkali soils are being investigated. Similar experiments with other salts are in progress, and the results will be reported in a later communication.

1. Ramdas, L. A., and Mallik, A. K., *Proc. Ind. Acad. Sci.*, 1942, **16** A, 1. 2. ——, *Ibid.*, 1942, **16**, 16. 3. —— and Pandit, U. P., *Curr. Sci.*, 1942, **11**, 288. 4. Ramdas, L. A., and Mallik, A. K., *Curr. Sci.* 1942, **13**, 42–288.

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THE PROCESSING OF MAIZE TO IMPROVE ITS VALUE AS AN ARTICLE OF HUMAN FOOD

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MAIZE is one of the more important millet crops of India. It is also grown quite extensively in other parts of the world and very large quantities have been imported into India in recent years. It is used as an everyday article of diet in certain parts of the country, while, in other parts, its use is rather unfamiliar or unpopular. Persons accustomed to rice, wheat, tapioca and such other food materials do not like maize because of its hard and fibrous coat, the bitter principle usually associated with the skin and the oil present in its germ. The latter also tends to turn rancid on long storage and renders the grain unpleasant as an article of food.

WHOLE-MAIZE IS NOT POPULAR OVER A LARGE PART OF THE COUNTRY

During recent years, several attempts have been made by the Central and Provincial Governments and also by the States to popularise the use of maize as an article of food. These efforts have met with only moderate success because the average consumer, say, of rice, prefers to go on a reduced ration of his favourite cereal, rather than have extra food in the form of maize which he does not like and which he finds to be coarse and difficult to digest. This is chiefly due to the fact that the maize is supplied to him either as a whole-grain or as whole-flour (coarsely ground), neither of which he is able to utilise satisfactorily. The position will be very different if the grain can be processed to remove the undesirable constituents and then supplied to the public as an article of food.

THE 'AMERICAN FLOUR'

A few decades ago, processed maize flour was introduced into India, the supplies coming chiefly from America. The product soon became very popular so much so that it found application in a variety of food preparations. In South India, it became very popular as 'American flour' and there was a very great demand for it, though only a few people knew what it was made of.

PROCESSED MAIZE PRODUCTS AND THEIR USES

In Europe and America, processed maize flour is finding extensive application. It is the basis for the usual thickeners of soups, breakfast cereals, various types of sweets as well as meat puddings, ice-cream and so forth. Other preparations like spaghetti and macaroni which are also familiar to the Indian consumers are prepared out of maize flour.

Considering all available evidence, it would appear to be extremely important that maize should be first processed and preferably converted into a clean, attractive flour before it could find general, popular favour in India. The husk and the germ can be separated, the former being used as an animal feed, while the latter can be crushed and used for preparing

maize oil which can be used for soap-making and other purposes.

THE EXISTING STARCH FACTORIES CAN BE USED FOR THE PRODUCTION OF PROCESSED MAIZE FOOD

Some years ago, a number of starch factories were started in different parts of the country to meet the increasing demand for starch from textile and other industries. There are now about twenty fair-sized factories in India with a capacity for handling hundreds of tons of maize per day. These factories were working very actively during the war, but, recently they have been thrown mostly out of commission because of the necessity for distribution all available maize as an article of human food. As already mentioned, the results of this change have not been as happy as was originally expected. While the starch factories have been mostly idle, maize is not finding much favour as human food and quite large quantities are perishing in different parts of the country.

A modern starch factory has the necessary equipment for the steeping, efficient removal of the skin, separation of the germ and other processing of maize. These operations form a part of the process connected with starch manufacture. It appears very desirable, therefore, that instead of keeping the starch factories idle, their equipment could be utilised for processing the maize in such a way that they will turn out acceptable articles of human food. It should be possible for an average starch factory to turn out a flour that would exclude the skin and the germ, but include the rest of the grain as a fine flour. This flour would be attractive and can be used for a variety of purposes. There is strong justification for preparing bulk specimens of the finished products and conducting consumer tests with them over different parts of the country.

THE MAIZE GRIT

The above would be a wet method of processing the grain. That would necessitate the drying of the final product. There is also some risk of a part of the maize oil being carried along with the maize gluten which would form a part of the flour. There are also dry methods which could be used for the removal of the skin and the germ. The remaining part of the grain could be converted into a form which is commercially known as maize grit and which can be used for a variety of purposes. The equipment for the manufacture of maize grit is available and can be easily obtained from abroad. If some maize grit could be prepared in India or imported from America, some consumer-trials could be carried out with it and the public given the benefit of demonstrations in regard to its varied uses. Arrangements could then be made for the importation of the necessary machinery.

THE INDUSTRY CAN BE EASILY STARTED AND EXTENDED

Some of the manufacturing firms in the country are already familiar with the methods of producing processed maize flour and also maize grit. They could obtain the required equipment and set them up if the necessary assistance is given. Once maize products could be made popular to the average rice and wheat-eating sections of the population, its future would be quite assured, and there will be enormous demand for maize products all over the country. The various factories in the country will have also have plenty of work to do; in fact many more new factories will be needed. The Government can investigate the matter through its Food Technical Panel and plan the organisation through its appropriate Food Industrial Panel.

Any important process successfully applied in the case of maize would also be generally applicable in the case of jowar and other coarse cereals. By suitable processing both human food in popular forms and also concentrated animal food out of the coarser fractions can be obtained. In this manner a balanced system of food production can be evolved with increasing benefit both to man and to

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AIR MASS INTERPRETATION OF SEN'S VORTEX METHOD OF WEATHER FORECASTING

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IN his review of Indian Weather in Köppen Band, Normand[1] pointed out that the concept of different air masses is old and implicit in the terms usually employed by the weather forecasters in India, but lacked the pictorial appeal of the theories which had then recently become common in the extra-tropical latitudes. A deep coist of monsoon current and a dry current were the main distinctions employed. Simpson and earlier workers[2] considered the monsoon stream as the continuation of the S.E. Trades of the southern hemisphere. Many workers tried to find out the different sectors and air masses that were required in the period of S.W. monsoon and for the cyclonic storms at other periods.[3] Roy and Roy[4] found that the monsoon depressions could be considered as consisting of three sectors with the following air masses; (*a*) fresh monsoon air, (*b*) monsoon air deflected by the hills in N.E. India and (*c*) the dry continental air. The very nomenclature restricted the scope of enquiry into the ultimate origin and properties of the air masses. Due to various reasons the origin of the air masses was left vague by other workers also. The position could not be described as satisfactory. Many forecasters including the author were content to find facts which could be used as simple criteria and sometimes use the concept of air mass when the signs for the latter were definite. The analysis of extensive weather charts and a technique of uniquely drawing isobars,[5] even when pressure gradients were weak and the number of ob-

servations few and far, showed that taking account of the sequence of the isobaric situation, weather and upper winds, the Indian weather could probably be attributed to three air masses:[6]

Equatorial Maritime Air (*Em*).—During the S.W. monsoon and in the pre- and post-monsoon months fresh maritime air crosses the equator from the south, at intervals depending on other meteorological conditions. It crosses the equator in a spurt (in a small interval of time) and there is a good interval of a few days before the next crossing can occur. To indicate this discontinuous and short-period crossing, the word 'pulse' of fresh maritime air has been employed. Before crossing the equator the character of the air mass is not the same throughout its history. It starts from one of the high pressure cells in the southern hemisphere as almost a dry continental stream (Tc) and in its westward travel gradually picks up moisture and some further additions of dry continental air. Later, due to the moisture content, it can be detected as a 'shallow' (in the sense of barometric defect at the centre and not as the height to which it extends) low pressure area moving in an almost west or west-north-west direction. The air corresponds to the far-eastern transitional or mixed air (see below). When just about to cross and certainly after crossing, its properties would be Em. It can be made easily unstable and thunderstorms occur all along its path and weather over the sea would be squally. The diurnal variation of temperature in its mass is very small or even negligible as shown by observations at hill-stations. The temperature at sea-level is about 80° F. The air is not hot, but due to its becoming easily unstable it can release energy and act as a 'source' among the air masses.[7]

Far-Eastern Transitional or Mixed Tropical Air. This contains a mixture of tropical maritime air and tropical continental air in varying proportions depending on the locality and season of the year. Though it may be hotter in some seasons (*e.g.* northern summer) than Em, it is more stable. Near the hills of N.E. India it can, however, cause thunderstorms. Its properties are described elsewhere.[8] The monsoon 'pulse' (much before it crosses the equator to the other side) would resemble this air mass and this was the reason why the name transitional (transition from the Tc to Em in the course of the travel from one of the high pressure areas in the southern hemisphere to the northern hemisphere and reciprocally from the northern hemisphere to the southern hemisphere) was given and put as Tr.

Tropical Dry Air.—It has mostly a land origin and can be usually described as Tc with an occasional mixture of Pc. Its humidity is small and it shows a large diurnal range of temperature on the ground. It brings in unusually hot or unusually cold days over the region it passes over according as it is summer or winter period. For depressions forming in Bay of Bengal or in Arabian Sea the air gets slightly modified due to its partial Sea travel.[9]

The three air masses could be separated, their effects and characters can be studied. In the height of northern winter (January or February), the first air mass rarely enters the Indian area and few tropical cyclonic storms (with a westward motion) form. Recently, the existence of the three air masses has been verified by the use of temperature and humidity data over the region S. China to N.E. India and Ceylon to Peninsular India.[10]

Sen and Puri worked a simple air mass technique for daily weather forecasting.[11] Later Sen discarded the method and introduced a theory of "Vortex Method".[12] With a weather chart which was limited in extent, the last method sometimes gave successful results, more so in detailed forecasting. There have been critics. As much thought has been spent to evolve the ideas and positive success attained, it is necessary to look deeper into the methods. As idea of air masses cannot be discarded, Sen's method must essentially be a part of a more complicated analysis where air masses are implicit and dominant. The restricted nature of Dr. Sen's analysis must cater to the finer details of weather forecasting.

It is, perhaps, useful to digress here, why the air mass concept becomes 'unconvincing' to many weather forecasters in the tropics when working with limited number of observations.

In the northern winter, the shallow low pressure areas or 'pulses', that cross into the southern hemisphere to feed into the tropical cyclonic storms or depressions there, are in the wind field of the "N.E. Trades". The winds are moving towards the equator and due to latitudinal divergence are gaining in stability, and the lines of partition between this (Tr) and other air masses are getting obliterated. (Just as in the case of cold fronts getting diffuse due to subsidence in the cold sector.) The N.E. Trades are passing over the sea before crossing the equator and would be absorbing moisture and getting heated. They cross as 'pulses' thereafter to the southern hemisphere. At this stage the air is unstable. This can only be unmistakably noticed within five or six degrees of the equator, a region generally ignored as 'doldrums' or as outside the area of many working charts. Occasionally this instability may be detected upto ten degrees or more in latitude, but it can be easily missed; as one is not out to look for it. The western disturbances indicate fronts on some occasions, but if the air is traced, it often happens that the partition is between sections of tropical air which had very nearly the same origin in the high pressure of west Asia but with different travels. (Both approximately eastwards, one over the land and the other partly over sea.) Occasionally, the N.E. Trades feed into the maritime part of the tropical air[13] but may be missed due to the limited extent of the chart of a forecaster catering for N.W. India. The latitudinal convergence of air with a northward travel and the orography would seem to explain all his doubts.

In the monsoon months, the most important air mass Em is the most elusive one. The

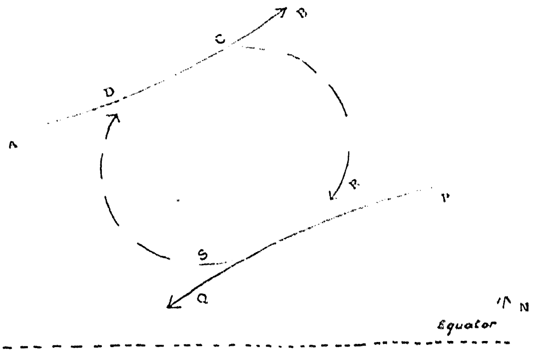
S.E. Trades are towards the equator and the 'pulses' or shallow low pressure areas that bring in the fresh monsoon air to the north become very diffuse as they approach the equator. The pressure changes near the equator are very small and may even be less than the diurnal variation of it, so that its importance would be missed.[5] The direction of wind would be disposed of as 'light and variable'. The time of crossing and the criterion of crossing would need very careful study of observations over a wide area on either side of the equator.[14] The trajectories drawn with the help of pilot balloon observations from stations situated at great distances from one another can give misleading ideas (*e.g.*, the S.E. Trades or 'pulses' go as far as Africa and then curve across the equator to feed into the Arabian Sea—the time sequence, the weather and winds at higher levels are all against it).

As for the far-eastern air Tr, it is partly N.E. Trades displaced northwards due to the shift of the seasonal lows and highs and has a slight equator-ward motion. It tends to gain in stability in the air mass and to make the partition with other air masses diffuse. Except in the neighbourhood of hills, thunderstorms are not common. But for the changing geometry of carefully drawn isobars and the sequence of rain in N.E. India, this air mass can be easily missed or ignored.

The third air mass is the continental dry air—its need is known. Its significance was missed, as with only one air mass which can be followed nothing exciting can result.

It is small wonder, if a forecaster in the tropics, handicapped with a limited chart and more limited number of observations and with air masses whose differences in temperature were much smaller than in the temperate latitudes, became sceptical of *routine air mass technique* in his area.

Consider now the winter conditions over India. Just north of the equator, in the lower levels of the atmosphere, there is an easterly or east-northeasterly flow of air due to the N.E. Trades. At higher latitudes, there is a westerly or west-southwesterly stream (the higher levels can be considered later). The easterly winds strengthen when 'pulses' or low pressure areas travel from the east and cross into the South Indian Ocean to feed the southern tropical cyclonic storm or depression. The westerly winds at higher latitudes feed into one or the other secondary low pressure areas of the western disturbances and themselves strengthen (see Fig.). When there is such a juxtaposition in the northern hemisphere, and easterly flow at a lower latitude and a westerly one at a higher latitude, the high pressure belt, in between, divides itself into cells of high pressure or a series of anticyclones. When there is no disturbance to the south or north of it, the anticyclone may be described as stationary in intensity and approximate position. The subsidence would be small and the air in it generally stable. The details of this configuration are given elsewhere.[15] The anticyclone develops or intensifies when either the easterly or westerly stream strengthens, *i.e.*, when the infeed of the Tr to the southern depression (and sometimes to a secondary low of a western disturbance) or when the infeed into the western disurbances takes place. As



the shallow low pressure area representing the 'pulse' approaches the particular anticyclonic cell, the latter continues to develop. The 'pulse' may now cross the equator with a spurt (in a comparatively short period of time) and then the anti-cyclone will definitely weaken till the next low pressure area or 'pulse' approaches it. In the case of monsoon depressions in Indian area, Sen calls this sort of thing which occurs in the southern hemisphere as a strong anticyclogenesis which gives rise to cyclogenesis in Indian area. This may also be compared with the idea of strong surges of high pressure in the Mozambique channel giving rise to depressions in the Indian seas (com. Pendell and others). The main fact is that a 'pulse' of fresh monsoon air crossed the equator to feed into a tropical cyclonic storm or depression. The concomitant circumstance was the high pressure area or the development of the anticyclonic cell and its later recovery. The author has pointed out that (*Forecasting Weather*, etc., pp. 36 & 88) "At the time of crossing the equator (the 'pulse') the value of the morning pressure is generally above 1020 mbs. and shows a good rise from the value on the previous day. The pressure rise is almost contemporaneous with the crossing of the equator by the pulse" and "Just before the transport of the fresh maritime air across the equator, fairly strong pressure gradient may be observed south of the equator and sometimes the steep pressure gradient may be observed to extend as far as Mauritius ..." As the high pressure area or the anticyclone is further away from the equator, it can be observed better but it would not justify to designate it as *the cause*.

If on the other hand, the 'pulse' did not cross the equator and moved westwards further, the next anticyclonic cell would develop and may release itself suddenly if *now* the 'pulse' crossed into the southern hemisphere. Otherwise, the anticyclone would release itself slowly and the next anticyclonic cell to the west of it will begin to develop.

If the 'pulse' or far-eastern air fed into the maritime part of air of the secondary low of an extratropical disturbance the anticyclone would gradually develop and would be displaced

eastwards as a northward travel of Tr would need a southerly stream to the west of an anti-cyclonic cell. The release would still be gradual. The recovery of the position by the anticyclonic cell would depend on the motion of the low pressure area to the north of it. The shape of the anticyclonic cell would depend on the relative position of Tr and the secondary low pressure areas of the extra-tropical depression.

If on the other hand, due to the secondary of the extra-tropical depression, the westerly stream strengthened, the anti-cyclonic cell would once again be developing. As the secondary low pressure areas travel almost E.N.E.-wards, one anticyclonic cell after another gets developed in an eastward progression. Some of the developed anticyclonic cells may allow Tr to feed into the secondary while in others such a contingency may not happen. While the movement of the complex low of the western disturbance is large and erratic, the development and recovery of the almost stationary cells of anticyclones in the seasonal high pressure belt can be observed more closely. If the complex low pressure area of the western disturbance is broken up into a series of distinct low pressure areas each of which is moving E.N.E.-wards and has a separate existence the problem of following the western disturbances would be very greatly simplified[16] and here again this series of secondaries is the cause and the change in the anti-cyclonic cells a concomitant. When the extent of a weather chart is small, a fast-moving western disturbance can be detected by the changes in the anticyclones. During winter it is possible to hazard a guess that a western disturbance is approaching Iraq when the surface and the lower upper winds at Bahrein become more northerly or northeasterly and no observations from west of Bahrein are available.[17] Similarly even though with the observations on the charts no low pressure area can be drawn, the development of the anti-cyclonic cell can indicate an approaching disturbance. In the first case the seasonal high is getting narrowed, displaced and intensified due to the approach of a western disturbance and the wind at Bahrein becomes more north-easterly than its usual north-westerly. The footsteps of a camel on a desert allow one to deduce the movement of a camel, as a result of past experience regarding the shape and direction of its footsteps.

In the northern monsoon, the easterlies are shifted northward in latitude (say about 20 to 35° N.) and the westerlies still further north. In the high pressure belt, the anticyclonic cells can still form and the development of the cell would depend on the far-eastern Tr feeding the monsoon depressions or to some western disturbance travelling at a higher latitude. As the western disturbances at a higher latitude 'pull' up' the monsoon depressions and allow it to recurve,[18] this would again be indicated in the displacement of the anticyclonic cell, and is a useful orientation in actual practice. To draw the anticyclonic cell or to see its displacement, it may not always be necessary to have winds all round, as with practice and experience one can judge it.

In the monsoon nearer the equator and south of it there is again a general high pressure area with variations. Further down in southern hemisphere the high pressure area breaks up into cells. It is possible to imagine that with the anticyclonic cells to the north of the monsoon low and with the high pressure cells to the south of it, we have a street of vortices, and whose displacements and variations indicate weather, not easily deducible otherwise, with limited observations.

It follows, therefore, that the main thing is the movement of low pressure areas and the air masses connected with them as far as weather forecasting is concerned; and the anti-cyclonic cells (or vortices) are the indicators of the movement of air masses and low pressure areas. When this limitation is clarified, the indicative value of the anticyclonic cells can be fully exploited. This is specially useful to a forecaster whose chart is limited. The distance between two successive anticyclonic cells is determined from large dynamical considerations and the variation of the position and configuration of these anticyclonic cells is small from day to day so that patterns can be drawn and followed closer. If any cannot be drawn, due to lack of observations, it is possible to make a fair guess, and fill up the lacunæ. A quick and unique way of drawing these anti-cyclonic cells, whether the wind field is strong or weak and variable, and the cataloguing of the variation in the cell due to types of disturbances that may be passing about it would be highly desirable.

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Note.—The cost of printing this contribution has been defrayed by a generous grant from the Rockefeler Foundation for the publication of resultis of scientific work made to us through the kindness of the National Institute of Sciences, India.

LETTERS TO THE EDITOR

A NEW METHOD OF OBTAINING SQUARES OF NUMBERS

MANY types of mathematical investigations often require squares of numbers of multiple digits. Barlow's tables and calculating machines not only have their limitations but are not always available to workers. A simple and ready method for obtaining squares of numbers containing any number of digits is illustrated here with typical examples.

(*i*) Square of a figure of two digits—95.

$$\begin{array}{c} 21 \\ 95 \\ \hline 9025 \end{array}$$

Square of the first digit—25. Put 5 of 25 in the units place of the result and carry over 2; next multiply the first and second digits of the number, double the product and add 2, — 92. Put 2 of 92 as the next digit of the result and carry over 9. Next square the second digit and add 9 of 92; that will give the last digits of the required square—9025.

(*ii*) Square of a figure of three digits—647.

$$\begin{array}{c} 321 \\ 647 \\ \hline 418609 \end{array}$$

Square of the first digit—49. Put 9 of 49 in the first place of the result and carry over 4. Next multiply the first and second digits, double the product and add 4—60. Put 0 as the next digit in the result and carry over 6. Next multiply the first and third digits, double the product and add to it the square of the second digit, and then add 6—106. Put 6 as the next digit in the result and carry over 10. Next multiply the second and third digits, double the product and add 10—58. Put 8 as the next digit and carry over 5. Next square the third digit and add 5, we get 41 as the last two digits of the result—418609.

(*iii*) Square of a figure of five digits—64537.

$$\begin{array}{c} 54321 \\ 64537 \\ \hline 4165024369 \end{array}$$

Square the first digit—49. Put 9 as the first digit in the result and carry over 4. Multiply the first and second digits, double the product and add 4—46. Put 6 as the next digit in the result and carry over 4. Next, multiply the first and third digits, double the product, add the square of the second digit and then add 4—83. Put 3 as the next digit in the result and carry over 8. Next multiply the first and fourth digits, double the product and add to it the doubled product of the second and third digits, and then add 8—94. Put 4 in the result, and carry over 9. Next multiply the first and fifth digits and double the product, multiply the second and fourth digits and double the pro-

duct, square the third digit, add all the three, and then add 9—142. Put 2 as the next digit in the result and carry over 14. Next multiply the second and fifth digits, double the product and add to it the doubled product of the third and fourth digits and then add 14—90. Put 0 as the next digit and carry over 9. Next multiply the third and fifth digits, double the product and add the square of the fourth digit and then add 9—85. Put 5 as the next digit and carry over 8. Next multiply the fourth and fifth digits, double the product and then add 8—56. Put 6 as the next digit in the result and carry over 5. Finally square the fifth digit, and add 5, we get 41 as the first two of the result 4165024369.

The method can be similarly applied to figures extending to any number of digits. It may be noted that the method can be worked entirely mentally. I propose to give other methods in a number of subsequent communications.

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New Delhi, AZIZUDDIN AHMAD SIDDIQI.
April 21, 1947.

COLOURED LIMESTONES OF THE PALNAD AREA

SAMPLES from the limestone deposits occurring in Palnad in Guntur district exhibit an attractive variety of colours. A single piece of a few inches length taken from such samples is often found to have distinct zones which are very different from each other in colour. Two sections in juxtaposition but possessing shades of chocolate and pale green respectively are cut from the same plane of easy breakage. The relative behaviour of these two sections in the matter of certain physical properties has been studied by us.

Effective elastic constants are determined by the wedge method developed in this laboratory, and are given below along with the densities.

Colour	Density (gm./cc.)	Ultrasonic velocity (km./sec.)	Effective elastic constant (dynes/sq.cm.)
Chocolate	2·78	6·42	$1 \cdot 144 \times 10^{12}$
Pale green	2·69	6·52	$1 \cdot 147 \times 10^{12}$

The dielectric constants are determined by a liquid mixture method. The limestone section is moved between the plates of a condenser containing a liquid mixture, and the concentration of the latter is adjusted such that the introduction or withdrawal of the section does not change the capacity. Then the dielectric constant of the liquid mixture, which is equal to that of the solid section, is determined. The two sections are dried by heating at 200° C. for two hours and their dielectric constants are determined. Later, they are made to absorb different amounts of moisture, and the dielectric constants for different moisture contents are determined. Results are given in the following table.

Moisture content in gms. per unit volume	Dielectric Constant	
	Chocolate coloured section	Pale green section
Dry	$8 \cdot 4 \pm \cdot 1$	$7 \cdot 8 \pm \cdot 1$
·0011	$9 \cdot 5 \pm \cdot 1$	
·0020 (equilibrium)	$12 \cdot 2 \pm \cdot 1$	
·0032	$19 \pm \cdot 5$	
·0040	26 ± 1	
·0006 (equilibrium)		$10 \cdot 6 \pm \cdot 1$
·0014		$15 \pm \cdot 5$

The two sections were dipped in water for half an hour, taken out, and their surfaces were wiped well. It was found that their moisture contents were first high but gradually decreased and attained equilibrium values in a day. The equilibrium moisture content for the chocolate-coloured section is ·0020 gm./c.c. at which the dielectric constant is 12·2. The corresponding moisture content for the pale green section is ·0006 gm./c.c., dielectric constant being 10·6.

Thus we see that the elastic constants of the two sections are the same and their dielectric constants are very near each other in the dry condition. The effect of moisture is different in the two cases. The two sections can retain quite different amounts of moisture in equilibrium. Further, for the same moisture content, the dielectric constant of the pale green section changes more than that of the chocolate-coloured section. It is suggested that the differences in colour have something to do with the probable differences in the particle size, the latter property also manifesting itself in the absorption and retention of different amounts of moisture.

The authors are grateful to Professor S. Bhagavantam for his kind interest in the work.

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Physics & Geology Departments,
May 8, 1947.

ESTIMATION OF TOTAL CHLORINE IN BLEACHING POWDER

THE method that was being followed in this laboratory for estimating total chlorine in bleaching powder was as follows:—

(1) Reduce an aqueous suspension of the bleach with hydrogen peroxide and estimate total chlorines by Volhard's method.

(2) Reduce an aqueous suspension of the bleach with the exact quantity of arsenite required as determined in the usual manner for estimation of available chlorine; add 20 c.c. conc. HCl and distil into 10% KI. Titrate the

iodine solution which gives the equivalent of chlorate.

Total chlorine was obtained by adding the two chlorine equivalents.

This method involving three determinations (*i.e.*, including the determination of available chlorine) and a distillation, was considered cumbersome, and the following was tried as an alternative.

0·3 to 0·4 gm. of the sample is mixed with ten times its weight of anhydrous sodium carbonate previously dried at 150° C. and placed in a platinum crucible. The mixture is covered with a layer of 5 gms. of anhydrous sodium carbonate. The crucible is gently heated on a pipe-clay triangle and raised to dull-red heat in not less than fifteen minutes, and kept at this temperature for 10 minutes. It is then cooled, placed in a covered beaker, the contents tipped out and dissolved in dilute nitric acid. Any salt left in the crucible is also similarly dissolved, the crucible removed by means of a pair of platinum-tipped tongs, and rinsed inside and outside with water into the beaker. The chloride in the solution is then estimated by Volhard's method.

In order to find out if any chlorine was lost during heating in the process, a short half-inch silica tube was packed successively with 5 gms. of anhydrous sodium carbonate, bleaching powder mixed with ten times its weight of anhydrous sodium carbonate, and another 5 gms. of sodium carbonate. A current of air freed from CO_2 and moisture was drawn slowly through the packing by means of a filter pump into a U-tube containing 10% KI solution containing starch as indicator. The portion containing bleaching powder was heated gently at first and then raised to red heat. There was no colouration of the iodide solution in 20 minutes. 0·3 gm. and 0·6 gm. of bleaching powder were also heated with negative results.

It is essential that the heating should be done gently at first and that the sodium carbonate should be anhydrous. The following table shows that the new method while quick and elegant gives figures that agree closely with those obtained by separate determinations of the various constituents of bleaching powder.

Serial No.	By Method (1)	Total chlorine By fusion with Na_2CO_3
1	33·36	33·33
2	33·41	33·34
3	33·41	33·40
4	33·41	33·25
5	33·41	33·32
6	33·41	33·28

Our thanks are due to the Controller of Armament Development for permission to publish this note.

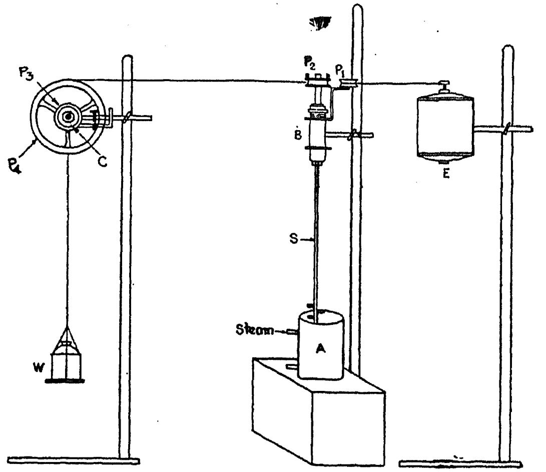
Inspectorate of Military Explosives,
Kirkee,
April 28, 1947.

C. D. Lafferty.
K. S. Varadachar.

VISCOMETER FOR HETEROGENEOUS MIXTURES

The usual kinematic type of viscometer is obviously unsuitable for heterogeneous mixtures in which a solid phase is uniformly distributed in a liquid phase, as for instance T.N.T. and ammonium nitrate over 80° C. For measuring the viscosity of such a mixture a simple apparatus is described here.

The principle on which the instrument is worked is the measurement of the time taken by a paddle to complete a definite number of revolutions under the force of falling weight, or alternatively the weight required to turn the paddle at a given speed.



VISCOMETER.

The apparatus shown above consists of :—

1. A—Steam-jacketed aluminium can of 600 c.c. capacity.

2. S—Aluminium stirrer.

3. *Gear System :*

B—Bicycle hub, carrying the stirrer below and a mounting above, on which a detachable pulley can be quickly slipped on.

P_1 and P_2—Two detachable pulleys either of which can be taken on B. P_1 is operated by an electric motor during the preliminary process of stirring the material under test. P_2 is operated by the falling weight during the measurement of consistency of the material under test.

C—Bicycle hub.

P_3—Pulley attached to C, carrying the falling weight.

P_4—Larger pulley, coaxial with P_3 to unwind a thread from P_2, thereby causing P_2 to rotate.

4. W—Moving weight.

5. E—Electric motor 1/10 h.p. with an adjustable rheostat.

The procedure for measurement is as follows :

1. The mixture in can A at 97° C. is stirred electrically by means of E and P_1 for 20 minutes. The thread is meanwhile wound on P_2, bringing the weight into position, in readiness for the measurement.

2. P_1 is slipped off the mounting and replaced by P_2, which is prevented from rotation by a stop on P_4.

3. On removing the stop, W is set in motion causing P_3 and P_4 to rotate, as also P_2. The time taken for the weight to fall through a given height is measured by a stop watch. (The operation of changing over from P_1 to P_2 and starting P_2 in motion takes less than 5 secs.)

STANDARDISATION OF THE VISCOMETER

The standardisation of the apparatus is effected by using (homogeneous) compounded greases of viscosities determined independently in the Redwood viscometer. The greases are filled into A to a height of 4 inches and stirred at a constant rate (c. 600 r.p.m.) by means of the aluminium paddle (motor-driven) for 25 minutes at suitable temperature. The pulley geared to the motor is then taken off the spindle and immediately replaced by the pulley to be operated by the falling weight. The time taken by the weight to fall through a height of 45 inches is then noted (drop time).

The results on the absolute viscosities of the greases used and their drop times are embodied in Table I. The relationship between the viscosities and the drop times is linear, and under the conditions of the experiment (temp. = 97° C.) is represented by the empirical formula :

$n = 56t - 380$, for a weight of 522·5 gm.

$n_1 = 46{\cdot}86\ t_1 - 360$, for a weight of 422·5 gm.

where $n = n_1$ and is the viscosity required in centipoises as measured in the Redwood viscometer ; t and t_1 are the drop times with different weights. The numerical constants in the equations have been derived by extrapolation.

It will be seen from Table I that the numerical values for viscosity calculated from either of the above formula using the drop times determined in the new instrument and with the two different specified weights agree very closely with the values determined in the Redwood viscometer.

TABLE I

Viscosity as determined by the new instrument and by Redwood
(T = 97° C.)

	Viscosity centipoises (Redwood)	Viscosity in centipoises as determined by present instrument			
		W = 522. 5 g.		W = 422. 5 g.	
		t (secs.)	n	t_1 (secs.)	n_1
Molten T.N.T.	6	6·9	6·4	—	—
Glycerine	18	7·1	17·6	8·1	19·6
Rubber based greases 1	164	9·7	163·2	11·2	164·8
" " 2	389	13·7	387·2	16·0	389·8
" " 3	776	20·6	773·6	24·2	774·0

The instrument thus standardised has been employed in testing the viscosity of hot amatol. Different compositions of the mixture with the same quality of ammonium nitrate and having the same grist size, and T.N.T. were prepared and viscosities determined (Table II).

TABLE II

Apparent viscosity of amatols of different compositions

Temp. = 97° C.
W. = 522·5 g.

Composition Ammonium nitrate	40	45	50	55 parts
T.N.T. ..	60	55	50	45 "
Drop time in sec. ..	10·3	12·6	15·1	17·5
Viscosity in centipoises ..	197	326	456	600

The increase in apparent viscosity proportional to the increase in solid component of the mixture, proves the utility of the instrument for comparative estimation of such mixtures of varying compositions.

The authors' thanks are due to Dr. H. R. Ambler, Chief Inspector of Military Explosives, Kirkee, for his help and suggestions, and to the Director of Technical Development for permission to publish the note.

Inspectorate of Military Explosives, Kirkee,
April 3, 1947.

B. N. MITRA.
B. M. MANEL.

CHEMICAL EXAMINATION OF THE FLOWERS OF *MELIA AZADIRACHTA*

Melia azadirachta is well known for its medicinal uses throughout India. The oil obtained from the seed kernel known commonly as 'Neem Oil' has been the subject of several investigations in the past.[1] Murti *et al.*[2] and Siddiqui[3] have investigated the oil with a view to isolate crystalline non-glyceride components that may be responsible for its therapeutic properties and have reported the isolation of a number of substances, some containing sulphur and some free from sulphur but all characterised by marked bitter taste.

The flowers are reputed to be useful as a bitter tonic after fevers, to remove biliousness, and in the treatment of certain skin diseases.[4] They have now been subjected to chemical examination with a view to isolate any special components that may be responsible for these properties.

Extraction of the dry material with different solvents in succession gave the following results :

Solvent	% extractive	Nature of residue
Petroleum Ether (60°–80° C.)	8·9	Yellow unctuous solid m.p. 41°–42°
Ether	2·0	Green waxy mass.
Chloroform	0·4	Soft yellow solid.
Alcohol 90%	12·5	Brown resinous semi-solid, markedly bitter.
Water	13·3	Brown resinous solid containing reducing sugars and tasting bitter.

For extraction on a large scale only petroleum ether and alcohol were employed.

PETROLEUM ETHER EXTRACT

The extraction was done in the cold (12 hrs.) three times. From the combined extract the solvent was removed by distillation first at ordinary pressure and finally under reduced pressure. The yellow unctuous solid left behind was treated with acetone in the cold and filtered. The white solid residue was waxy; it was crystallised from boiling absolute alcohol when it came out as a colourless solid melting at 60°-63° C. and having the following constants. Acid value = 5·8; Saponification value = 43·2; Unsaponifiable matter = 64·3 per cent.

The acetone filtrate from above was distilled under reduced pressure, when a golden yellow oil was obtained. It had a characteristic smell and an irritant bitter taste, and showed signs of decomposition when heated above 65° C. giving rise to irritant fumes. It did not contain any sulphur or nitrogen. It had the following properties. Refractive index (29° C.) = 1·4850; Acid value = 41·20; Saponification value = 123·20; Unsaponifiable matter = 38·1 per cent. The unsaponifiable matter was separated into two fractions by the use of hot alcohol. The less soluble fraction consisted of a waxy solid melting at 63°-65° C. which did not give sterol reactions, resembling the solid wax previously obtained. The more soluble fraction gave strong colour reactions for the presence of sterols.

The mixture of fatty acids obtained from the above oil was examined by Twitchell's lead-salt method and found to consist mainly of saturated acids. When heated at the temperature of the water-bath it showed signs of decomposition with production of irritant fumes just as the original oil itself.

ALCOHOL EXTRACT

The flower material left after petroleum ether extraction was extracted with boiling alcohol three times (6 hrs. each time). The viscous residue obtained by the concentration of the extract *in vacuo* was agitated with a large volume of ether to remove the ether-soluble portions. The ether-insoluble portion was taken in the minimum amount of alcohol and diluted with a large volume of water, when a brown amorphous powder (A) was obtained. It was sparingly soluble in most of the organic solvents and was not bitter to taste.

The ether extract mentioned above was repeatedly shaken with 5 per cent. sodium hydroxide solution, and the combined alkaline solution was acidified with hydrochloric acid. The solid obtained was soluble in alcohol and the solution gave an olive green colour with ferric chloride. By taking up the dry substance in dry ethyl-acetate and adding petroleum ether an yellowish brown, amorphous powder (B) was obtained in a small quantity. This also was not bitter. Major bulk was found to be resin.

The ether solution containing the alkaly-insoluble matter was concentrated, whereby a soft greenish semisolid (yield = 1·3 per cent.) was obtained. It had a characteristic smell and was very bitter to taste. This was partitioned between petroleum ether and 70 per cent. aqueous alcohol and the two layers worked up separately. The solid obtained from the alcohol layer was dried and dissolved in benzene, and the solution diluted with petroleum ether. A light yellow powder (C) melting at 95°-100° C. with decomposition was obtained. It was markedly bitter to taste. It did not contain any sulphur or nitrogen. Its composition could be represented by the following empirical formula:

C_4H_6O (Found: C = 68·2; H = 8·4; C_4H_6O requires C = 68·6; H = 8·6).

From the petroleum ether layer a green treacly residue (D) was obtained. It was the most bitter of all the fractions, but could not be crystallised. It was non-reducing to Fehlings but reducing to alkaline permanganate. It was oil-soluble.

The main components of the neem flowers seem to consist of wax, oil and bitter substances (C & D). The bitter substances may be responsible for the tonic properties and the irritant oil may explain its usefulness in skin diseases.

Our thanks are due to Prof. T. R. Seshadri for his kind interest in this work.

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April 12, 1947.

1. Rao and Seshadri., *Proc. Ind. Acad. Sci.*, 1942, **A3** 161. 2. Murti *et al.*, *Ind. Journ. Pharm.*, 1940, **2**, 206 3. Siddiqui and Mitra., *Journ. Sci. Ind. Res.*, 1945, **4**, 5 4. Kirtikar and Basu., *Indian Medicinal Plants.*, **1**, 537

A NOTE ON THE CALCAREOUS MARL DEPOSITS OF U.P.

THE object of the present note is to record the (*i*) nature and occurrence, (*ii*) physical and chemical aspects, and (*iii*) the suitability of the marl, found in the districts of Lucknow, Unao, Rae Bareli and Barabanki for economic purposes. These deposits were first discovered and studied for cement manufacture by R. J. Hallidy, and the results were recorded in 1923.[1] Later on in 1941, the author carried out for about a year and a half the preliminary survey and prospecting of these deposits.

(*i*) *Nature and Occurrence.*—These are fresh-water marls. The deposits are found in many places along the valleys of the rivers Sai, Gomti, Gogra, etc., or generally in the low lands, *jhils*, *tals*, swamps or the old beds of rivers. The marls lie under 6-15 feet of clay, and occur more or less as lenticular basin-shaped deposits of relatively small size. There is nothing on the surface which indicates deposition of marl underneath. Generally the areas are highly cultivated. It has been observed by the author that sugarcane grows quite profusely in the lands where the marls lie below.

(*ii*) *Physical and Chemical Aspects.*—Marl as found in nature is very wet, and may contain more than 30 per cent. of moisture. It is fine and sticky. The colour varies from grey to whitish grey. The darker colour is generally due to the presence of much organic matter, both mollusc shells and plants. The shells may sometimes be absent, whereas in some cases the marl is made up entirely of shells. The good quality marls usually contain very little of fine sand or grit.

It is a chemical deposit of calcium carbonate, containing 39 per cent. CaO. The alkalies are less than 1 per cent. while the silica is little more than 16 per cent. Fe_2O_3, TiO_2 and MgO, which are objectionable for cement manufacture are within the limits of British Standard Specifications for Portland Cement.

(*iii*) *Suitability for Cement Manufacture.*—It is generally felt that lime made out of marl is definitely better and cheaper than that from other sources. The tensile strength and expansion of the limes obtained from various sources support the above idea.

The physical and chemical studies of the marl deposits reveal that they can be used for the manufacture of cement only after calculation, as the percentage of CaO is lower than the one required by British Standard Specifications of Portland Cement.

(*iv*) *Extent of Deposit.*—The material is found in pockets up to 50 chains long and from 150-1,000 ft. in width. The thickness of marl varies from 3-12 ft. with an average of 4½ ft. and the overburden of clay is 4-12 ft. thick. The most important pockets are in the Basah Jhil in the Unao and Rae Bareli districts.

(*v*) *Quantity Estimated.*—The total estimated deposit of marl in the three districts of Unao, Rae Bareli and Lucknow is about 35·9 million tons. Besides these three districts, the areas in the district of Barabanki are yet to be examined.

(*vi*) *Facilities for Development.*—Owing to the nature and mode of occurrence of the material, the examination, prospecting and development present certain peculiar difficulties, such as inflow of water. The most suitable method for getting the marl would be by dredging, and the cost involved in this method is considerably lower than that of mining a limestone deposit. Further, the calcination treatment does not require much labour or huge machinery, since it requires only a small wet grinding and crushing plant, and the addition of bauxite to the slurry. The position of these deposits is ideal from the point of view of cheap labour and easy transportation to the factory and the market.

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Benares Hindu University, R. S. MITHAL.
April 1947.

1. Watson, *Bull. Ind. Indus. and Lab.*, 1923, No. 430, **27–41**. **2.** U. P. Govt. Memorandum (Budget 1947, Grant No. 39, Account 72).

THE BIOLOGY OF *EARIAS CUPREOVIRIDIS* WLK.*

THE failure of cotton crop in the Punjab in 1905 and in Sind in 1906[1] brought spotted bollworms, *Earias fabia* and *E. insulana*, into prominence. Since then these two species have been under close investigation. A third species of *Earias*, *cupreoviridis*, however, has not been recorded from cotton, but only from some cultivated *Hibiscus* species and capsules of jute[2] in India; and this has only been casually studied. Fletcher,[3,4] Fletcher and Misra,[4] and Haroon Khan *et al.*,[5] recorded the host plants and distribution of this species in several tracts of India, while Hampson[6] reported that the species is also found in parts of Africa and South-Eastern Asia.

For sometime *E. cupereoviridis* has been known as a pest of cotton in China,[7] Formosa[8] and Philippine Islands;[9] and there is every danger of its attacking cotton in India as well. Some preliminary observations on the biology of this insect made at Delhi during the last two years are recorded here.

It has been observed that *E. cupeoviridis* remains active in Delhi from April to October hibernating for the rest of the year in the pupal stage as long as the mean laboratory temperature remains below 80° F. This species hence differs from *E. fabia* and *E. insulana* in

so far as it hibernates for a fairly long period. But during the period of activity its general behaviour is very similar to those of the other two species. In 1944 and 1945, the time at which the pupæ entered into hibernation was not very variable. Caterpillars collected from field or bred in laboratory in the first fortnight of October or later entered into hibernation as they pupated. The date of emergence of moths from hibernating pupæ, however, varied. In 1945 the first moth emerged on 20th March, the last one on 27th May, the largest number of them emerging in the first fortnight of May; during 1946 the first moth emerged on 26th March, the last on 5th May with the majority emerging in the second fortnight of April.

Further, it was possible to rear this species, generation after generation, all through winter, at two constant temperatures, 86° F. and 80° F. At both these temperatures the insect remained active and did not show any sign of hibernation. At 86° F. the total life-cycle was completed in about 23 days, while at 80° F., it took about 28 days. The total duration of life-cycle of this series is thus longer than that of *E. fabia* by about 3 days at 86° F.[10] At other temperatures too this species takes somewhat longer than *E. fabia* to complete its life-cycle. Butac's (1933) observation fully supports this conclusion.

Therefore, temperature appears to be the main factor, if not the only factor, that brings about hibernation. With a view to studying the influence of low temperature on hibernation, some observations were made. A number of freshly formed pupæ from larvæ bred at 86° F. were exposed to 70° F., and moths emerged from all of them within three weeks. Again, fully-fed larvæ reared at 86° F. were exposed to 70° F., where they pupated within two days, and from these also moths emerged within three weeks. On the other hand, pupæ got from larvæ kept at 70° F., when transferred to a high temperature of 86° F., took longer to emerge as moths as compared to the pupæ from the larvæ at 86° F. It is hence evident that low temperature acting on the larval stage and not the pupal stage bring about hibernation.

Humidity, which is another important ecological factor, does not appear to have any marked influence on hibernation; and during March-May when the hibernation ends, humidity generally remains very low; at high temperatures, as stated above, it was possible to rear generation after generation throughout winter months.

At Delhi *E. cuptrioviridis* has been found only on *Sida grewioides* which is a common weed in this locality. Lefroy[2] and Fletcher and Misra[1] recorded some species of *Hibiscus* and jute as its hosts, while in the Punjab it has been bred from *Sida cordifolia* and *Malvestrum tricuspidatum*,[5] two weeds commonly found in several parts of the province, and also rarely from two cultivated plants, *Hibiscus esculentus* and *Althea rosea*. In the laboratory this species was bred all along on *Hibiscus esculentus* without difficulty. With some difficulty the insect was also bred on flower-buds and bolls of cotton; and later, three consecutive generations were reared on the same food-plant. Moths of the first generation as also of subsequent generations behaved quite normally and laid viable eggs. These observations suggest that the insect is a potential pest of *Hibiscus esculentus* (*bhindi*) on which it is found even under field conditions in parts of the Punjab, and it is also possible that it may at any time start attacking cotton. With the rapid extension of cotton and the evolution of numerous varieties of different texture there is every danger that this insect may divert its attention to cotton in India also.

The writer is indebted to Dr. Tashkir Ahmed, Imperial Entomologist, for giving all facilities for this work and to Mr. Sadiq Khan for help in rearing and other routine work.

Indian Agricultural Res. Institute,
New Delhi, M. HAROON KHAN.
April 18, 1947.

1. Fletcher, T. B., and Misra, C. S., *Rep. Proc. Third ent. Meeting*, 2, Pusa, **1919**, **78**, 2. Lefroy, H. M., *Indian Insert Life*, 1906, 456. 3. Fletcher, T. B., *Rep. Proc. Second ent. Meeting*, Pusa, 1917, 127–135. 4. Ibid., *Rep. Proc. Third ent. Meeting* **1**, Pusa, 1919, 78. 5. Haroon Khan, M., *et el. Indian J. Agr. Sci.*, 1945, **15**, (Press.) 6. Hampson, G. F., *Cat. of Noctuidae*, 1912, **11**, 505–506. 7. Li (Fweng-seen), and Ma (tsing-chao). *Yerb., Bur. Ent.* 1933, **3**, (*Abstr.*) *Rev. Appx. Ent. Ser.* 23; 306. 8. *Bulletin Research Institute*, Formosa, No. **122**, 113 (*Abstn. Rev. App. Ent. Ser. A*, 1936, **25**, 228. 9. Butac, F. L., *Phillipine J. Agriculture*, 1938, **2**, 137. **10.** Ahmad, T., and Ghulamullah, 193), *Indian. J. Ent.*, 1939 **1**, 17.

DIASPORE WITH PYROPHYLLITE FROM HAMIRPUR DISTRICT, UNITED PROVINCES

MISRA[1] has recently shown that the long-known deposits of steatite of Hamirpur district in U.P. are deposits of pyrophyllite. The main deposit occurs at Gorahri (79° 37′-25° 27′) associated with quartz reefs traversing Bundelkhand—granites and gneisses. In no case is the mineral found in the granites and gneisses; it is invariably restricted to the quartz reefs. Three new deposits were subsequently discovered in the quartz reefs at Turra (79° 27′-25° 29′), Girwar (79° 29′-25° 31′) and Pahari Garhi (79° 31′-25° 32′). A hydrothermal origin has been advanced for the origin of these deposits.

At Gorahri where regular mining is being done diaspore was discovered in the form of geode-like bodies in the veins of pyrophyllite. The average diameter of these bodies measures about 5″. The mineral shows compact masses, purple radiating crystals, and well-developed greyish-white pearly crystals up to 1·25″ in length. The second variety is extremely brittle. The average specific gravity and hardness are 3·22 and 6 respectively.

Under the microscope thin sections show elongated blades and needles, and one set of fine cleavage lines are very characteristic, though sometimes traces of another set of cleavage lines are seen. Almost all sections show straight extinction with respect to the cleavage lines. The length of the mineral is

fast, and the optic axial angle appears to be very great. The average and maximum refractive index of the mineral are 1·70 and 1·74 respectively.

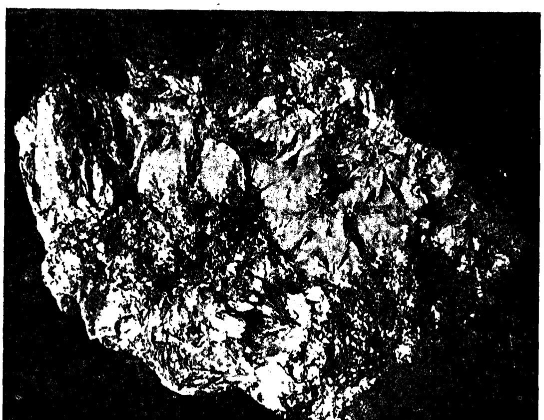
(1) By Ordinary light × 39. Showing blades and needles of diaspore.

The purple variety had the following composition :—

Constituent	Per cent.
SiO_2	3·71
Fe_2O_3	0·07
Al_2O_3	82·09
H_2O	14·53
Total	100·40

Analyst : C. P. Sood.

The impurities are evidently due to contamination from the associated pyrophyllite.



(2) Specimen of diaspore; 2/3 natura size. ehT prismatic crystals are arranged round a core of pyrophyllite.

In India diaspore has been reported in traces in the sillimanite gneisses of Bihar and corundum-bearing rocks of Rewah State.[2] The extensive aluminium ore of the Kashmir State is probably a diaspore and boehmite rock.[3] The present communication is perhaps the first record of diaspore occurring as an independent mineral in the form of well-developed crystals. Its association with pyrophyllite is also noteworthy. In Japan it occurs at Shokozan in Bungo Province with alunite, pyrophyllite and kaolinite as a hydrothermal alteration of porphyrite.[4]

R. C. Misra.
C. P. Sood.

Dept. of Botany & Geology,
Lucknow University,
Lucknow,
March 28, 1947.

1. Misra, R. C., *Quart. J. Geol. Min. Met. Soc. Ind.*, 1944, **16**, 46. 2. Mallet, F. R., Diaspore with Corundum in Rewah State, *Rec. Geol. Surv. Ind.*, 1872, **5**, 22. 3. Rao, T. V. M., *Min. Mag.*, 1929, **22**, 87. 4. Dana, E. S., *System of Mineralogy*, 1944, **1**, 678.

THE ALKALOIDS OF *XANTHOXYLUM BUDRUNGA* WALL.

Xanthoxylum budrunga Wall. (Fam. *Rutaceæ*) is a well-known indigenous drug valued as a remedy for intestinal complaints and general debility.. Dieterle[1] traced an alkaloid in its bark, but could not isolate the base or its salts in the pure state.

The bark of *X. burdunga*, procured from Dacca, has been examined, and the results are given in this note. Two crystalline, coloured alkaloids were isolated in the pure state from the alcoholic extract of the bark. This offered considerable difficulty as the separation of the bases and their salts could not be effected by fractional crystallisation from pure or mixture of solvents. They could only be separated by hand-picking. The bases isolated from the bark appear to be new compounds, and have been called *Budrungain* and *Budrungainin* respectively.

Budrungain (yield 0·0025 per cent.) forms yellow rods from methyl alcohol and ethyl acetate, and chars above 180° C., but does not melt.

Budrungainin (yield 0·005 per cent.) crystallises from methyl alcohol and chloroform in slender shining orange needles which melt at 155° C.

The alkaloids are being further investigated.

I am thankful to Dr. S. Sen for kindly supplying me with the *budrunga* bark, and to Dr. A. Chatterjee for her interest and kind advice during the progress of this work.

Organic Chemistry Laboratory,
University College of
Science and Technology,
92, Upper Circular Road,
Calcutta, Harinarayan Khastagir.
May 12, 1947.

1 *Arch. Pharm.*, 1919, **257**, 260.

POST-PARTUM ŒSTRUS IN THE INDIAN SHORT-NOSED FRUIT BAT, CYNOPTERUS SPHINX SPHINX (Vahl.)

Nycteris luteola (Thos.) appears to be unique among insectivorous Cheiroptera in experiencing a post-partum œstrus with at least two and possibly three pregnancies occurring in quick succession. Harrison Matthews[1] suggests that the above species may be polyœstrous.

Braestrup[2] considers it probable that in Tropical Africa insectivorous bats have two breeding seasons in the year. Do the Cheiroptera breed twice in the tropical Indian climate?

Our information on the reproduction of fruit bats reveals that most forms have definite breeding seasons characteristic of the species. Bakers'[3] comprehensive list on Pteropidæ indicates that they are monœstrous.

Phillips[4] observed in the Indian Short-nosed Fruit bat, *Cynopterus sphinx sphinx* (Vahl.) from Ceylon, females with young during most months of the year, and remarks that the breeding is probably intermittent throughout the year.

My observations on *Cynopterus sphinx sphinx* (Vahl.) reveal that there is post-partum œstrus and that at least two pregnancies occur in quick succession. Four adult specimens were obtained at Malleswaram (Bangalore), and three at Hoskote (sixteen miles from Bangalore) all of which while in lactation, and with young ones still clinging to the nipples were at the same time pregnant. The collection from each one of these places included also an adult male which was in full functional activity.

The period of gestation in *Cynopterus sphinx sphinx* (Vahl.) is about five months, while the period extends to six months (Baker and Barker[3]) and sometimes exceeds it (Ratcliffe[5]) in the other Megacheiroptera. Pregnancy alternates between the two horns of the uterus and the ovaries function alternately. Sections of the ovaries show that the corpora lutea persist till parturition.

The available information indicates that this species differs from all other Megacheiroptera in experiencing a post-partum œstrus and that two pregnancies occur in quick succession in the month of April. The comparatively long gestation period of about five months precludes any possibility of this species being polyœstrous.

This is perhaps the first record of a Fruit Bat breeding twice a year.

Department of Zoology,
Central College,
Bangalore,
June 9, 1947.

P. A. RAMAKRISHNA.

1. Matthews, L. Harrison, *Nature*, 1939, 143, 643 and *Proc. Zool. Soc. Lond. Ser.* B., 1942, **111**, 289–346. 2. Braestrup, F. W., *Ann. Mag. Nat. Hist.*, 1933, Ser. **10**, **11**, **269**. 3. Baker, J. R. & Z. Baker, *Journ. Linn. Soc. Zool.*, **1936**, **40**, **123–41**. 4. Phillips, W. W. A., Mammals of Ceylon, *Ceylon. Journ. Sci.* 1935. 5. Ratcliffe, F., *Journ. Anim. Ecol.*, **1**, 32.

* I am very thankful to Dr. B. R. Seshachar, Central College, Bangalore, for encouragement and to the Council of the National Institute of Sciences (India) for the award of a Junior Research Fellowship.

ELECTROLYTIC REDUCTION OF *m*-NITRANILINE TO 2, 4-DIAMINOPHENOL

2, 4-DIAMINOPHENOL which is a valuable photographic developer, has been prepared from various starting materials derived from benzene. It has been obtained from 2, 4-dinitrophenol both by chemical[1] as well as by electrolitic methods,[2] and also by the electrolytic reduction of *m*-dinitrobenzene in strong sulphuric[3] acid.

The only reference in literature to the production of 2, 4-diaminophenol from *m*-nitraniline is that of Gattermann[3] who used a platinum cathode in the presence of strong sulphuric acid. The yield obtained by him was, however, not specified.

The electrolytic reduction of nitrobenzene to *p*-aminophenol in dilute sulphuric acid emulsion has been studied in this laboratory[4] on a pilot plant scale, and a patent[5] has also been taken out for the process. In a later publication from this laboratory,[6] the electrolytic reduction of *m*-dinitrobenzene directly to 2, 4-diaminophenol in dilute sulphuric acid emulsion using certain catalysts has been reported. The process has now been extended to the production of 2, 4-diaminophenol by the electrolytic reduction of *m*-nitraniline.

m-Dinitrobenzene and *m*-nitraniline which were required in large quantities and in a high state of purity were prepared in this laboratory on a pilot plant scale following the procedures already reported in literature, and obtained in very satisfactory yields.

2, 4-Diaminophenol has been isolated as the sulphate in the crude condition, and has been obtained in the pure condition as the insoluble oxalate.[7] By electrolysing *m*-nitraniline in 30 per cent. sulphuric acid at a monel cathode using a suitable catalyst and a current density of 2·3 amps./sq. dm., the yield of the crude sulphate amounts to 56 per cent. and the yield of diaminophenol oxalate to about 50 per cent. The diaminophenol sulphate obtained by this procedure is purer than that obtained directly from *m*-dinitrobenzene and this promises, therefore, to be a much better process for the manufacture of this important chemical on a technical scale.

Further experiments are in progress to improve the yield with special reference to the influence of such factors as current density, strength of catholyte temperature, cathode materials, catalysts, etc., on the material yields of the products. Fuller details of this investigation will be published elsewhere in due course. Our grateful thanks are due to the Council of Scientific and Industrial Research for kind permission to publish the preliminary results.

B. B. DEY.
H. VENKATAKRISHNA UDUPA.
B. R. PAI.

Presidency College,
Madras,
May 3, 1947.

1. Bradt, *J. Phys. Chem.*, 1930, **34**, 2711. 2. Weyprecht, *Dissert.*, Giessen (1902). Brockman's *Electro Organic Chemistry*, 1926, pp. 254–6. Elbs, *J. pr.*

Chem., 1891 (2), **43**, 39; Bradt and Brown, *Trans. Amer. Electro-chem. Soc.*, 1929, **56**, 429–44. 3. Gattermann, *Ber.*, 1893, **26**, 1848; D. R. P., 75,260. 4. Dey, Govindachari and Rajagopalan, *J. Sci. Ind. Res.*, India, 1946, **4**, 571. 5. Indian Patent, 33', **78**. 6. Dey, Govindachari and Udupa, *Curr. Sci.*, 1946, **15**, 163-64. 7. Lumiere and Seyewitz, *Bl.*, 1893, **9** (3), 595.

BLAINI TALCHIR CORRELATION

A REJOINDER

In a recent note[1] J. B. Auden reasserts that Blaini boulder bed is Talchir or Upper Carboniferous in age and glacial in origin. Based on structural evidence he differs from my view that it is Tertiary tectonic breccia.

The new evidence adduced by Auden is from the bed of the Kosi river in Nepal. Here carbonaceous partings occur in sheared black shales found in proximity of boulder slate and associated with grey sandstone and dolomite. The dolomite forms the southern limit, and is thrust upon the Nahan series. In the north the whole zone is thrusted over by the Dalings.

According to Auden the three rock types, boulder slate, carbonaceous shale and dolomite, are all normal marine sediments in proper succession and are not due to thrust movements. He considers the carbonaceous partings in shales as of lower Gondwana age, and correlates the boulder slate as Blaini with the Talchirs.

I cannot dispute the correctness of the field data for lack of knowledge of the area but I do consider that the data lends itself to a different interpretation. Firstly these series of sediments are sandwiched between the thrust against the Nahans and the thrust against the Dalings. It is, therefore, possible that shearing along the thrust has produced a boulder bed at the base. Secondly the presence of boulders of Krol or Subathu type of limestone within the boulder slate and of boulders of dolomite which is the top formation occurring as "horses" rolling within the underlying carbonaceous shales are features which are abnormal and can be explained as being due to mechanical mixture during Nappe movement of older rocks over younger ones. Auden's view of the concomitant formation of carbonaceous shale and dolomite from marine waters (Auden's Fig. 2) is rather farfetched. It seems more probable that fragments of old dolomite (of Krol age) got enclosed in the younger, though underlying carbonaceous shale which permeated in cracks within the dolomite blocks during shearing.

The Gondwana age attributed by Auden to Kosi carbonaceous partings rests on very weak evidence. The criterion of the Fuel Ratio favours a tertiary age. Gondwana coal is known to occur in the Himalayan foothills only east of Darjeeling, and no definite occurrence has, to my knowledge, been recorded west of it. What has definitely been recorded from the western, the Solon Lansdowne area, is that coal is a common constituent of the Tertiary-Subathu formation. It appears more probable as is further supported by the rock association that the Kosi occurrence represents the eastern continuation of the thrusted Subathu-Krol belt rather than that it is the western prolongation of the Darjeeling-Gondwana belt in spite of its nearness to the latter, since in Darjeeling area dolomite association is not a part of the Gondwanas but of the Baxas which correspond to the Krols which are known to have thrusted over the carbonaceous subathus.

Apart from the lithological and structural evidence, the abnormal sequence, the frequent occurrence of the Blaini boulder bed in rock associations of different ages, its position in the field mainly coinciding with the thrust zones, the frequent occurrence of boulders and fragments of rock types of Krol, Infra Krol and of even younger ages as common constituents of the boulder bed, all these lead to the only conclusion that the boulder bed is of thrust origin.

My recent study of Mussoorie hills, though casual and incomprehensive, lends definite support to the tectonic origin of the boulder bed. Below the Vincent Hill School, south-west of Mussoorie, I came across a thick boulder bed below the Krol limestone. The boulders of all sizes and shapes were largely of the overlying Krol limestone though shales also contributed some fragments to the boulder bed. The matrix was partly clayey and partly calcareous in which pink limestone formed a conspicuous ingredient. A regular bed of pink limestone of Nummulitic type was found beneath the boulder bed which was succeeded further below by brown variegated shales of Subathu type. The field succession is illustrated in Fig. 1.

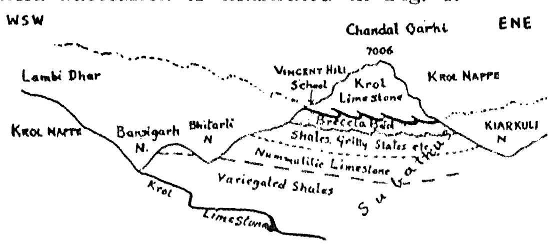


Fig. 1

From the above field evidence there is no doubt that the boulder bed which includes material derived from formations both below and above is a thrust breccia formed during the movement of the Krol Nappe over the Subathus. The age of the breccia bed is evidently Tertiary and is definitely not older than Eocene.

Thus it will be seen that both from direct lithological and from structural evidence in Solon and Mussoorie areas the Blaini Boulder bed is found to be of tectonic origin formed during Tertiary orogenic movements, and does not appear to have anything to do with Gondwana glaciation.

Rohtas Industries,
Dalmianagar,
January 23, 1947. K. P. Rode.

1. Auden, J. B., *Curr. Sci.*, 1946, **15**, 346.

The Editor has kindly let me see the above letter by Dr. Rode before its publication and has allowed me to reply. The following brief points may be made with regard to some of

his assertions, which to my mind are incorrect. Dr. Rode argues that the Kosi coals are probably of Tertiary age on account of their low fuel ratios. In actuality the fuel ratio is no criterion of age in the case of the coals of the outer Himalayas, or of coals caught up by subsequent igneous activity, being an indication only of the metamorphism which the coals have undergone, either through shearing stress or by the thermal effects of intrusive rocks such as mica-peridotites. As stated in my letter of December 1946,[1] both the Eocene coals of Jammu and the Gondwana coals of the Darjeeling foothills have the same average fuel ratios. It may be remarked, however, that a further coal seam has recently been located by Mr. K. K. Dutta, Geological Survey of India in the Sunakhambi Khola, Nepal, which is less impure and has a fuel ratio of 3·22, so that the abnormality which I discussed in December is not characteristic of every seam in that neighbourhood. The analysis of this coal is given in Column 1 below:

	1 Sunakhamba Khola Left Bank, Kosi, Nepal	2 Bhitarka Khala, Left Bank, Giri River, Surmur State, Punjab
	%	%
Moisture	2·38	0·72
Volatile Matter ..	11·92	7·50
Fixed Carbon ..	38·46	21·52
Ash	47·24	70·20
F.R.	3·22	2·98
Total Sulphur ..	0·33	1·26

(Analyses by Dr. R. K. Dutta Roy)

Of more value as an indication of age is the sulphur content. The average sulphur content of the peninsular Gondwana coals is 0·65 per cent., and of the Tertiary Assam coals about 5·0 per cent. The total sulphur content of the coaly matter of one of the Kokaha coals mentioned in my letter of December 1946 is 0·40 per cent. The total sulphur of the specimen in Column 1 above is 0·33 per cent., equivalent to 0·62 per cent., if all the sulphur is confined to the coaly matter and none of it occurs in the ash. It is highly probable, therefore, that the coals in the Kosi area are Gondwana and not Tertiary.

Dr. Rode states that Gondwana beds do not occur west of Darjeeling. This is incorrect because, aside from the recent finds in the neighbourhood of the Kosi river in Nepal, Gondwana coals have long been known, from the work of Sutton Bowman and others, to occur sporadically in Nepal as far west as longitude 82°. Moreover, it is possible that some of the carbonaceous rocks of the Mandhali series, closely associated with the Sataun limestone (30° 33′ : 77° 39′) in Sirmur State, Punjab, may represent altered impure Gondwana coals. One specimen collected by me in 1943 from the Bhitarka Khala has the analyses given in Column 2 above. This suggests the possibility that Permian coal conditions may also have extended further west than has formerly been realised.

Dr. Rode also states that coal is a common constituent of the Tertiary Subathu formation between Solon and Lansdowne. So far as I know, Eocene coal does not occur in the western Himalayas east of about longitude 76°, being mainly confined to Jammu. An Eocene laterite, evidently equivalent to the bauxite of Jammu, is, however, known near Subathu and indicates a phase of sub-aerial oxidation.

Finally, Rode's interpretation of the Sirmur-Mussoorie area is so completely at variance with mine (and with that of W. D. West) that it is evident we are using given stratigraphic terms to describe quite different formations. No scale is given on Rode's section through Vincent Hill School, but the map shows that his section is about 3,000 yards in length. The nearest Blaini to Vincent Hill School along his line of section is 3,500 yards W.S.W., or some 1,300 yards beyond the end of his section. What Rode appears to have regarded as a Blaini breccia (according to him of Tertiary age) is in my view possibly either a penecontemporaneous limestone conglomerate belonging to the Krol D substage, or a lime-cemented scree deposit derived from the Krol series. Further, I know of no nummulitic limestone at the lower levels of the Vincent Hill School Ridges. According to my mapping, all the ricks exposed in Rode's section belong to the Upper Krol Stage.

So divergent, indeed, are our readings of the nomenclature, stratigraphy and structure that one is tempted to exclaim with the Voice out of the Whirlwind in the book of Job: "Who is this that darkeneth council by words ..."

Engineering Geology Section,
Geological Survey of India,
Calcutta,
March 18, 1947.

J. B. AUDEN.

1. Auden, *Curr. Sci.*, 1946, **15**, 346.

SOMATIC CHROMOSOME NUMBERS IN SOME CULTIVATED CUCURBITS

CUCURBITACEÆ, a family of great economic importance, includes seventy genera and nearly seven hundred species. The somatic chromosome numbers have been studied in many a specie and genera[1] elsewhere, but very little work has been done in India. Somatic chromosome numbers have been determined in seven of the varieties recorded in Table I along with the previous records on the subject. The authors are recording the somatic chromosome numbers in *Cucumis melo* Linn. var.? "Sarda" *Cucumis melo* var. *utilissimus* Roxb. "Kakari"; *Cucumis melo* var. *momordica* Roxb. "Phunt"; and *Citrullus vulgaris* var. *fistulosus* Watt. "Tinda" for the first time. These findings agree with those of the earlier workers[2-8] on other

TABLE I

Somatic chromosome numbers in some cultivated Cucurbits

No.	Name	Local name	$2n$	No. of Sat-chromosomes in the complement	Whether previously recorded or not	Somatic chromosome number in other varieties of the species
1	*Luffa aegyptiaca*, Mill. (Fig. 1) ..	'*Nimava*'	26	..	$n = 13$, (Sutaria,)[2]	..
2	*Luffa acutangula*, Roxb. (Fig. 2) ..	'*Tarol*'	26	..	$2n = 26$, (McKay[3] and Sutaria)	..
3	*Cucumis melo*, Linn. var ? (Fig. 3) ..	'*Sarda*'	24	2	New record	*Cucumis melo* Melon) $2n = 24$. Yamaha and S.[1] and *C. melo* (Cantalaupe) $2n = 24$ Shifriss.[5]
4	*Cucumis melo* var. *utilissimus* Roxb. (Fig. 4)	'*Kakri*'	24	2	..	
5	*Cucumis melo* var. *momordica* Roxb. (Fig. 5)	'*Phunt*'	24	2		
6	*Cucumis sativus*, Linn. (Fig. 6) ..	'*Khira*'	14	..	$n = 7$, $2n = 14$ (Kozhukhow[6] Heimlich,[7] McKay[3] and Passmore,[8]	
7	*Citrullus vulgaris* var. *fistulosus*, (Watt., Fig. 7)	'*Tinda*'	22	2	New record	*Citrulus vulgaris* (Water melon) $2n = 22$, Kozhukhow,[6] 1925

varieties of the corresponding species. One pair of satellited chromosomes have been found in the new records.

Fig 1

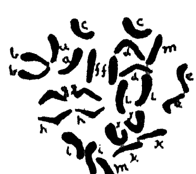


Fig 2

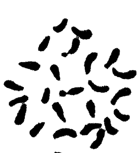


Fig. 3

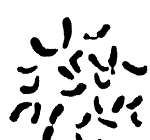


Fig. 4

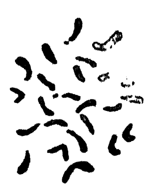


Fig. 5

Fig. 6

Fig. 7

At Allahabad the root tips could be best fixed between 4-30 and 6-15 a.m. Maeda's modification of Navaschin's fixative was quite satisfactory. The results are given in the following table.

Prochromosomes were observed in the resting cells of the root tips of all the varieties investigated. A careful count of these from several nuclei showed that the number of prochromosomes corresponded with the number of somatic chromosomes in the plants.

S. P. NAITHANI.
PURUSHOTTAM DAS.

Botany Department,
University of Allahabad,
May 19, 1947.

1. Darlington and J. Ammal, *Chromosome Atlas of Cultivated Plants*, 1945, Allen and Unwin, Ltd., Lond. 2. Sutaria, R. N., *Journ. Uni.*, Bombay 4 (5), 21-28. 3. McKay, J. W., *Bot. Gaz.*, 1930, **89**, 416. 4. Yamaha and S., *From Chromosome Atlas of Cultivated Plants* by Darlington, C. D., and E. K. J. Ammal, 1945. Allen & Unwin, 1936, London. 5. Shiffriss (cited in 1), Allen & Unwin, 1941, London. 6. Kozhukhow, Z. A., *Bull. Appl. Bot. Genet. & Plant Breed.*, 1920, **23**, 357. 7. Heimlich, L. F., *Proc. Nat. Acad. Sci., U. S. A.* 1927, **13** (3); *Biol. Abs.*, 1928. 8. McKay, J. W., and Passmore, S. F., *Bot. Gaz.*, 1930, **90**, 123.

A HINDU ASTRONOMICAL CLOCK

According to Oriental sciences of Astrology and Astronomy time is measured in *Yamas*, *Ghatikas* and *Vighatikas*; but no mechanism has been known to indicate this system of division following the readings of the Hindu Almanac.

At the Nellore District Agricultural Exhibition held in March 1947 a big clock fitted in a wooden frame of about 3′ × 2½′ × ¾′ was exhibited to the admiration of the public. The clock, unlike the *Jantar-Mantar* at Delhi and other devices, reads besides hours and minutes, *Thidhis*, *Warams*, *Nakshatrams*, *Lagnams* (with *Pushkaramsa*) and *Rahukalam* in *Ghatikas* and *Vighatikas* and also dates. All these are readable on a single dial though the hands are different. It is said to work with weekly winding, and the readings are based on '*Sowramana*'.

It is the work of one Mr. Gongalla Krishnaiah, Doctor of the Rural Ayurvedic Dispensary, Mypad Village, Nellore District. The visiting public felt that the mechanism is useful for further research in Astrology and Astronomy.

To-day, when civilisation is said to be much advanced, time is expressed in *Yamas* and *Ghatikas* in Indian villages, as many villagers do not have time-pieces. Our ancient sciences are alive, but mechanical research is not there to produce suitable devices. This kind of clock does better service than a Radio set to the farmer. If researches of this kind are encouraged, they add to the fame of the country and serve the public from farmer to saint.

Kalidasu Sankaraiah.

Thumadu,
Nellore Dt.,
May 22, 1947.

ORGANISING SCIENTIFIC TALENT IN THE COUNTRY

Every Indian who is associated with any scientific work in the country* will welcome the appointment of the 'Scientific Manpower Committee' by the Government of India to survey, salvage and conserve available scientific talents for its full utilisation in future India.

The comparative fewness of attractive appointments in the scientific lines and the greater salaries, power and influence associated with posts in the executive and administrative lines have caused men of proved scientific abilities to choose other lines of service. Adequate recognition of scientific and technological talents has been slow in most countries and particularly so in our own.

Even inside a scientific or technical department of Government the administrative posts often carry much higher salaries than posts in the scientific line with the result that after some years of service, the scientist looks forward to finish his career in non-scientific posts with their larger emoluments and pensions. I know of one young brilliant chemist who, after building up considerable work and reputation as chemist, ended his career as a second rate administrator. This was a distinct loss to science and not a service to administration.

The very tangible results of sugarcane work at Coimbatore was rendered possible through the worker—not very bright nor highly qualified—sticking to that work for thirty years. His colleagues thought he had a kink in his brain which prevented him looking around and above his post. In the agricultural departments of Government which need an immediate conservation of scientific talents I have known of persons, after decades of service in one crop, turn to another because of better emoluments.

The proposed Committee would do well to take note of these existing drawbacks as in the nationalistic India of the future the need for the conservation and proper utilisation of scientific talents is bound to be an important and urgent problem for working out schemes to the benefit of the mother-country.

56, Thyagaraja Road,
Thyagarayanagar,
Madras,
May 31, 1947.

T. S. Venkatraman.

* *Curr. Sci.*, May 1947.

A PEACE TIME USE FOR MONAZITE

Among the latest developments announced by the Council for Scientific and Industrial Research is the use of Australian deposits of monazite in the manufacture of carbon electrodes for searchlights. The positive carbons of a modern searchlight usually have a core consisting of a mixture of powdered carbon and fluorides of the cerium group of metals. These materials required for making carbon cores have been imported, but it has been found that sands from the beaches of Northern New South Wales and Southern Queensland contain considerable quantities of monazite, from which cerium fluoride can be prepared.

Cored carbons made from Australian materials have been tested in a searchlight arc lamp, and found to be in no way inferior to imported cerium fluoride.

REVIEWS

The New Plastics. By Herbert R. Simonds and M. H. Bigelow. (Von Nostrand Co., New York; Macmillan, London), 1946. Third Printing. Pp. 320. Price 25*sh*.

First published in May 1945, this book endeavours to cover the progress made during the preceding five years on various fronts in the plastics industry. Besides dealing with the methods of production and fabrication, properties and uses of various newer and improved types of plastics, the authors briefly discuss new processes, new methods of fabrication, and business statistics. Separate chapters are devoted to closely allied subjects of adhesives, fibres, protective and decorative coatings, synthetic rubbers, etc.

Among newer resins discussed are polyethylenes, nylons, silicones, polyvinyl carbozole and new alkyds. Other better established resins receive due attention such as the melamines, polyvinyl alcohols, allyls, vinylidene chlorides, zein, etc. Plastics derived from bagasse, wood, agricultural wastes and coffee also receive a brief mention, on which some work was also done in India during the war years.

Of particular interest to India, however, are the two shellac substitutes dealt with by the authors. Only one of which, namely, zinlac, is described in any detail. The other one developed by the Westinghouse Electric and Manufacturing Company is mentioned very briefly. Zinlac, based on zein resin, was developed specially as a substitute for shellac varnish for use as coating material. Although in some respects it is better than shellac, its price militates against its general adoption as a substitute during peace time. The Westinghouse substitute, on the other hand, was aimed at replacing the use of shellac in micanite manufacture, but no clue is given as to its basic composition or comparative properties. In spite of these and other developments in search of shellac substitutes, it must be remembered that, although a substitute may be found for one or the other uses of shellac, no single material is yet on the horizon which will be as versatile as shellac to supply the basic needs of some fifty or sixty industries.

If shellac is to fully exploit its superior advantages and hold its own in the modern age of plastics, attempts for stabilizing its price and standardising its quality must be redoubled and at the same time research activity should be vigorously pursued. The authors very rightly state that "shellac retained its popularity and usefulness, even though various substitutes appeared on the market, largely because extensive research to improve its quality and develop new uses has been carried out in this country (U.S.A.), in India, and in Great Britain". There is little doubt that the "formidable" competition predicted for the future can only be met, if research, development, standardisation and price-control activities are intensified.

While presentation and organization of the subject-matter in this book is excellent, giving general outlines of the topics dealt with, the reader will not find in it a penetrating and thoroughgoing treatment of theoretical and practical aspects of either the materials or the processes. The reason for this may be that the book was completed in early 1945, when detailed information on new developments was either not fully available or could not be given for reasons of security. Absence of references to original literature, with a few exceptions, further restricts the utility of the book for scientific workers. At any rate it may be recommended as a text-book for students who are interested in getting general knowledge related to recent developments in the plastics industry.

LAL C. VERMAN.

The Poetry of Mathematics and Other Essays. By David Eugene Smith. The Scripta Mathematica Library No. 1. (Published by Scripta Mathematica, Yeshiva College, Amsterdam Avenue; and 180th Street, New York, N.Y.), 1947. Pp. 90. Price $1.25.

This small book was first published in 1934. It contains five essays which are of immense interest and bear testimony to the author's wide experiences, deep sensibilities and historical scholarship. As the book had gone out of print, the second printing, in 1947, is certainly to be welcomed.

The first essay is called "The Poetry of Mathematics" and it begins with Weierstrass's remark that "a mathematician who is not somewhat of a poet will never be a perfect mathematician." The remark would naturally puzzle any one who sees in the poet a sensitive lover of the concrete, dominated by a highly developed sense of life's values and given to emotional dramatization and regards the mathematician as an ardent devotee of the abstract, dominated by a tyrannical sense of the precision and given to impersonal ratiocination. The fact is that mathematics sets up patterns of ideas which have beauty, novelty and profundity and which in expression are terse, virile and convincing. These qualities are also experienced in poetry at its best. The author has given several interesting examples in support of this fact. It is shown that even elementary mathematical results have an æsthetic appeal of their own and that mathematics can, like poetry, satisfy the appetites of our higher self for truth and beauty.

The second essay is entitled "The Call of Mathematics" and the usual question is tackled, Why is mathematics studied? Some of the most crucial and vital laws of nature are quantitative and hosts of phenomena which are not governed by such laws do not fail to reveal an inner logic of events. It is not possible, therefore, to make a purposeful attack on life without cultivating a mathematical way of think-

ing and an intimate acquaintance with what G. H. Hardy calls "trivial" mathematics. The author shows how the whole fabric of modern machine civilization would collapse without mathematical support, and rightly argues that if the teaching of mathematics is not effectively done in schools and colleges the remedy is not to abolish it but to improve it. An anecdote of Lincoln is told how he interrupted his law studies with a perusal of Euclid to understand the precise meaning of the word "demonstrate". The author also indicates how the challenge of life provokes in man an intellectual curiosity and a sense of adventure which mathematics goes a long way to satisfy.

The third essay is on mathematics and religion. It shows in an interesting manner how certain theological dogmas are suggested by the familiar statements of certain mathematical propositions. In his conclusion the author says: "What we may safely assert, however, is this —that mathematics increases the faith of a man who has faith, that it shows him his finite nature with respect to the Infinite; that it puts him in touch with immortality in the form of mathematical laws which are eternal; and that it shows him the futility of setting up his childish arrogance of disbelief in that which he cannot see." While reading this essay the reviewer was reminded of Bertrand Russell's view expressed in *The Scientific Outlook* (1934, p. 16): "... the scientific attitude is in some degree unnatural to man; the majority of our opinions are wish-fulfilments, like dreams in a Freudian theory. The mind of the most rational among us may be compared to a stormy ocean of passionate convictions based upon desire, upon which float perilously a few tiny boats carrying a cargo of scientifically tested beliefs." Any one who is familiar with recent developments in modern mathematics, particularly, regarding the foundations of the subject, may consider the author's account of the nature of mathematics antiquated and invalidated. Since there is no logical connection between mathematics and theology one can only admire the theological earnestness of the author for using purely mathematical results to strengthen his faith.

The remaining two essays are about Jefferson and Monge. They are different in character from the rest of the book, but one can read them with profit and interest. The book is thought-provoking, nicely written and beautifully printed. It would make an excellent addition to any college library that does not already possess a copy of the first edition.

V. V. Narlikar.

Advances in Carbohydrate Chemistry, Vol. II. Edited by W. W. Pigman and M. L. Wolfrom. (Academic Press Inc., Publishers, New York, N.Y.), 1947. Pp. 323. $6.6.

This volume presents ten topics in the form of reviews by carbohydrate chemists of America, England and France.

1. *Melizitose and Turanose* (C. S. Hudson).—Melizitose, of the more important and widely distributed sugars of nature, is shown to be 3-(D-glucopyra-nosyl)-D-fructofuranose< >-D-glucopyranose. The structure of turanose is established conclusively as 3-alpha-D-glucopyranosyl-D-fructose.

2. *The Chemistry of Anhydro Sugars* (Stanley Peat).—The chemistry of anhydro sugars is dealt in detail, and evidence is adduced that anhydro sugar formation by the hydrolysis of the sugar ester of a non-carboxylic acid depends on the fact that in the preliminary stages of hydrolysis a carbonium ion is formed followed by a trans exchange of anionoid groups, inversion taking place. One of the most striking interconversions of sugars in nature is the smooth elegance with which D-glucose is converted into D-galactose in the mammary gland. The acid most likely to function biologically is phosphoric acid and the conversion of D-glucose to D-galactose through the intermediate formation of D-glucose-5-phosphate and subsequent intramolecular anion exchange on C5 and C4 respectively, is a very attractive picture.

3. *Analogs of Ascorbic Acid* (F. Smith).—Four main methods are available for the synthesis of analogs of L-ascorbic acid. Up to the present simultaneous lactonisation and enolisation of 2-keto-3:4-dihydroxy acid or esters is the most successful for synthetic vitamin C on a commercial scale. Antiscorbutic power is dependent on the stereochemical configuration of the molecule as a whole. High antiscorbutic power is also reported to be shown by a derivative of L-ascorbic acid in which the enolic hydroxyl at C2 is replaced by an amino group.

4. *Synthesis of Hexitols and Pentitols from Unsaturated Polyhydric Alcohols* (R. Lespieau).—Syntheses have been accomplished by the elegant oxidative hydroxylation of di- and mono-vinylglycols by means of a solution of silver chlorate containing a small amount of osmic acid.

5. *The Interrelation of Carbohydrate and Fat Metabolism* (Harry J. Deuel Jr. and Margaret G. Morehouse).—A critical assay of a mass of papers reviewed reveals that the present information must be construed as giving a negative answer to the possibility for the conversion of the fatty acids into carbohydrates. In the animal body glycerol can be quantitatively converted into D-glucose. To explain the mechanism of ketosis (accumulation of ketone bodies in the blood) two theories have been put forward: ketolysis and antiketogenesis. Both these theories, however, fail to give a complete picture.

6. *The Chemistry of Mucopolysaccharides and Mucoproteins* (M. Stacey).—The field covers carbohydrate and protein chemistry. The study of pneumococci has resulted in their classification into forty different serological types which differ according to the structure of their capsular polysaccharides. Heparin probably contains a basic tetrasaccharide unit. Chondroitin sulphate is found to be a derivative of Duconic acid. Chitin may be regarded as 2-acetamido cellulose. The chemistry of mucoproteins is being actively persuaded.

7. *Bacterial Polysaccharides* (Taylor H. Evans and Harold Hibbert).—Polysaccharides, in combination with proteins, are responsible for the immunizing power of many bacteria and the

structure of the polysaccharide determines the specific immunological response to these organisms. Bacterial cellulose, dextran and many other bacterial polysaccharides are composed entirely of D-glucose units, the levans are condensation polymers of D-fructose. The polysaccharides of pathogenic bacteria are usually composed of more than one carbohydrate.

8. *The Chemistry of Pectic Materials* (E. L. Hirst and J. K. N. Jones).—By selection of an appropriate pectin in which the desired component is present in suitable proportion, it is possible to separate either the pectic acid portion or the araban in a sufficient state of purity for structural investigation. The evidence so far available suggests that pectic materials from a wide variety of sources contain the same araban, a branched chain polysaccharide built up mainly, if not entirely, of L-arabofuranose residues. Peanut galactan consists of a chain of 120 D-galactopyranose units in the 1 : 4-beta-links.

9. *The polyfructosans and difructose anhydrides* (Emma J. McDonald).—Hydrolysis of trimethyl-inulin gives 3 : 4 : 6-trimethyl-D-fructofuranose. Inulin is, therefore, made up of D-fructofuranose residues joined through carbon atoms 1 and 2. Four difructose anhydrides have been isolated as well-defined crystalline compounds. Anhydrides I, II and III have been isolated from non-reducing residues that remain after a removal of D-fructose and D-glucose from acid-hydrolysed inulin. Anhydride I is 1 : 2′: 2 : 1′-di-D-fructofuranose anhydride and III is the 1 : 2′: 2 : 3′-di-D-fructofuranose anhydride.

10. *Cellulose Ethers of Industrial Significance* (Joseph F. Haskins).—Cellulose ethers of a high degree of substitution are stable, relatively nonflammable, resistant to ultraviolet light and compatible with a wide range of solvents and plasticizers. Various experimental factors are involved in the etherification of cellulose. For use as plastic material, ethylcellulose and benzylcellulose have had the greatest commercial development. Several groups as methoxyl, hydroxyethyl and carboxymethyl, when present in proper amounts, render the cellulose derivative soluble in water.

President W. N. Haworth, in his address to the Chemical Society (April 19th, 1945) says: "It is a curious fact that some of the most notable advances in the chemistry of starch have been made during the stress of this and earlier wars ..... in the present war we have witnessed the enzymic synthesis of both amylose and a mylopectin."

On reading through the volume under review one is almost tempted to add—the addition of two outstanding treatises on Advances in Carbohydrate Chemistry have also been added to the literature during the action and reaction of the global war. The editors as well as the contributors command the thanks of all chemists for putting into their hands such a readable and informative volume. It will prove indispensable to all who have ambitions of learning the recent advances in the field.

K. N. M.

Recent Progress in Hormone Research. *Proceedings of the Laurentian Hormone Conference*, Vol. I. Edited by Gregory Pincus. (Academic Press, Inc., Publishers, New York, N.Y.), 1947. Pp. 398. Price $7.50.

Symposia are always very stimulating to scientific thought and investigation, and the present one is no exception. It contains a most interesting series of articles on hormones, giving critical evaluations and work-in-progress by leading investigators, and is valuable not only as record of knowledge and accomplishment but as incitement to research. The purpose of the conference, to nourish the spirit of inquiry, which dies without criticism and discussion, is fulfilled.

The book is divided into four sections. The first section contains an article by Nachmansohn on the role of acetylcholine in the mechanism of nerve activity. For the theory to be complete, however, the role of adrenaline has also got to be elucidated side by side. If there are no cholinergic nerve endings in the accepted sense of the term, then there must be no adrenergic ones. The second article by Beach, gives an account of the action of hormones on mating behaviour in vertebrates. The second section contains articles by Kendall, Gallagher, Long and Pincus and deals with the chemistry and action of the hormones of the adrenal cortex. The chemical and the physiological investigations are a brilliant piece of research. The third section deals with the role of hormones in metabolic processes, and contains articles by Samuels, Kochakian and Gardner. The fourth section deals with certain aspects of clinical endocrinology, and contains articles by Nathanson, Albright, Talbot, Sobel and Grollman and are of great value from the clinical standpoint; they represent an important advance in several directions. The whole symposium is a record of the latest advances in this branch of physiology. The articles and discussions certainly act as hormones to the creative processes of scientists in this field.

INDERJIT SINGH.

Sugarcane Cultivation. By K. M. Gururaja Rao, 139, Margosa Road, Malleswaram, Bangalore. Foreword by Sir T. S. Venkatraman. Cr. 8vo. Pp. xvi + 127, with 24 Illustrations. Price Rs. 4-8-0 net.

This is a very useful and timely publication on the cultivation of sugarcane, an industrial crop which forms the raw material in the sugar industry in which India has invested about thirty-two crores of rupees—the largest investment next to Textiles. It is unfortunate that even after fifteen years of tariff protection the industry cannot be said to have reached a stabilisation, as seen by the Government extending its protection for a year more. In the agricultural economy of India the crop occupied in 1945-46 an area of 38,47,000 acres. The average yield of cane per acre is about 15 tons against 45 tons in Java. Whatever increase is seen is due to improved varieties of cane, the cultural and manurial influences hardly playing their deserved role, due, among others, to the cultivators' preoccupation with as remunerative, less exacting and short-duration crops.

Even on factory plantations, where sugarcane is expected to be grown under strict administrative and scientific control the yields are poor—15 to 20 tons per acre. In thick cane areas as in Madras, Mysore, Hyderabad and Maharashtra, except for average yields of about 35-40 tons in Maharashtra, the rest of the area has not showed any improvement over the average of 18-20 tons (*vide Review of the Sugar Industry of India* for the year ending 31st October 1945). This is a serious position and deserves attention of Government as well as the factories.

Against the above background the present publication is welcome, not because it contains, as in Part I, valuable information culled here and there from published records on sugarcane, but, which is important, as a method of cultivation evolved and successfully applied on a plantation-scale over twenty-five years of author's active life. Successful crop-growing demands an intelligent and integrated application of intimate knowledge of a number of agricultural sciences, which is vitiated by the present-day tendency for specialisation. The author speaks of his intimate experience in growing sugarcane, avoiding undue influence of mere book-learning, and the book is the result.

Part 1 treats, in general, the theory influencing the subject. History of sugarcane, distribution of cane areas, the sugarcane plant, its propagation, periodicity of growth, theory of formation of sugar, varieties, soils and their properties—chemical, physical and bacterological, colloids and their function, fertilisers, yields of sugarcane and their field estimates, insect pests and diseases of sugarcane are dealt with in eight chapters.

Part 2 describes, with a wealth of detail, the method of cultivation. It consists of eight chapters dealing with climate and soil, the need to map out soils, growing of green manure crop as a preliminary to cane, methods of ploughing, laying out plot, drains, kinds of sets used for planting, raising nurseries, filling gaps, details of manuring and their dose, different methods of irrigation, maturity in cane, ratoons, etc.

There is a very useful summary of recommendations at the end.

There are 23 Appendices of an informative nature on the subject.

The book is profusely illustrated with 24 helpful sketches and halftone blocks.

It is a book which would be found useful to every sugarcane-grower, from fieldman to manager in sugarcane plantations.

Manuring of Cotton in India. By V. G. Panse. (Indian Central Cotton Committee), 1946. Pp. 63. Price Rs. 5.

This publication from one of our abler statisticians, who is also well acquainted with the crop, is a welcome contribution to a very important problem. In the course of about 60 pages the author has critically surveyed over 420 field experiments conducted all over India in the course of about fifty years. He has drawn certain important conclusions and indicated the lines of future work.

The first part is a summary of the results of earlier manurial trials. This has revealed that, of the three major elements, nitrogen is the only one that produces a consistent response. Ammonium sulphate has proved more dependable than organic manures, especially farm and manure and compost, though in some areas seed-cakes have also proved quite satisfactory. The optimum time for application varies with the source of nitrogen and locality. The best method of applying the fertiliser has yet to be studied more thoroughly.

The second part deals with the economics of nitrogen manuring and is a statistical study of the results so far obtained. On black soils the optimum dose of groundnut cake is about 500 lbs. which is equivalent to about 40 lbs. of nitrogen per acre. Irrigated cotton responds better than the rain-fed crop, and about 50 lbs. of nitrogen per acre seems to be an efficient economic dose. The analysis has revealed the importance of the amount of rainfall, drainage and salinity of soil in determining response to nitrogen. Interestingly enough, the conditions which determine the yield are the same as those which determine the response to nitrogen.

The third part deals with the planning of future work and emphasises the need for further study on the quantity of nitrogen, alternative sources of nitrogen, time of application, method of application, application of phosphate, varieties of cotton, response to rain-fed and irrigated conditions and so forth together with the heads under which data have to be collected.

Although the author has dealt with the economics in terms of cash, there is yet need for information bearing on the actual utilisation of the manure or fertiliser applied. Thus, what part of the nitrogen is actually taken up by the crop? It is now generally recognised that owing to the somewhat alkaline character of most cotton soils, there will be continued loss of nitrogen as ammonia. Is there any way of preventing this loss and making the nitrogen more available to the crop? Can we treat fertilisers directly or otherwise make additions so as to reduce the risk of the continuous loss of nitrogen? An important finding in this direction may prove to be very useful in practice. It is hoped that the new programme of field experiments initiated by the Cotton Committee will include such studies.

V. SUBRAHMANYAN.

Chemicals from Methane. By J. P. Lawrie, Ph.D. (Science Service Ltd., 255, Russel Count, London, W.C. 1), 1947. Pp. 21. Price 3/-.

Dr. J. P. Lawrie, the author of *Methane—Production and Use*, puts forth in this booklet of 16 pages of readable matter, a strong plea for the profitable utilisation of natural gas and other sources of methane of which very considerable supplies exist in England. He describes in outline the methods of preparation of carbon black and other products from methane albeit a few of them are at present only of theoretical interest. This booklet, written in a simple way, should find favour with the general reader.

P. L. N. RAO.

Indian Minerals—A Quarterly Journal issued by the Mineral Information Bureau, Geological Survey of India, Calcutta.

Current Science has great pleasure in welcoming the publication of the magazine, *Indian Minerals*, issued by the Mineral Information Bureau, Geological Survey of India, Calcutta.

It was a long-felt desire to have a journal which could publish popular articles on Indian minerals. Information on the mineral wealth and articles concerned with the strategic minerals of India, were being published in the Annual Reports of the Records of the Geological Survey of India. These were, however, available mostly to Geologists. It is a great pleasure that this information has been made available by *Indian Minerals* to the rest of the enlightened public.

The magazine welcomes short notes on research in progress, but it mainly confines itself to popular articles. It is very informative with up-to-date facts and figures, and is printed on good art paper.

We congratulate the sponsors on the venture and wish all success to *Indian Minerals* in its career.

B. R. C.

The Indian Cotton-Growing Review—*Journal of the Indian Central Cotton Committee.* (The Secretary, Indian Central Cotton Committee, Nicol Road, Ballard Estate), Bombay. Rs. 2 per annum.

The Quarterly Review is a welcome addition to the other publications of the Indian Central Cotton Committee dealing with its research work and practical achievements. Useful as the memoirs, annual reports and articles on cotton in different journals were, they could not supply the need for a regular periodical exclusively devoted to cotton. The cotton industry in India occupies a place of eminent priority both in the agricultural and industrial economy of the country. The researches on this product cannot, therefore, be too widely published. With growing competition from rayons, glass fibres and other cotton substitutes the importance of cotton research and exploitation can be very well recognised. The Indian Cotton-Growing Review should go a long way in helping the cotton-grower and industrialist adopt the latest methods and improvements in cotton research. We wish the Journal a long and useful career in the service of the Cotton Industry.

K. S. R.

Advances in Carbohydrate Chemistry, Vol. I. Edited by W. W. Pogman and M. L. Wolfrom. (Academic Press Inc., New York), 1945. Pp. xii + 374. Price $6.00.

The reviewer's first reaction on encountering an annual publication devoted to a single group of chemical compounds was a feeling of dismay at the tempo of scientific progress which necessitates such a publication and the narrowing down of interests implied by it. But a perusal of the contents of *Advances in Carbohydrate Chemistry* has been more than reassuring. The eleven articles in this volume are written by well-known specialists but are written not only for the specialists but also for the general student of chemistry. The authors have not confined themselves to literature surveys of "recent advances" but have, in accordance with the avowed policy of the editorial board, provided critical and integrated reviews on the subjects covered by them. Thus the first article on "Cynohydrin synthesis", by C. S. Hudson, gives in thirty-six pages a masterly and extremely readable summary of nearly hundred years' work. Commencing with the first synthesis of α-hydroxy acids from the cynohydrins of carbonyl compounds it deals in chronological order with Kiliani's application of the reaction to convert reducing sugars to the corresponding sugar acids, Fischer's reduction of the lactones of these acids to give higher carbon sugars and leads on to the recent work, much of it carried out in the author's own laboratory on the synthesis of monosaccharides containing from seven to ten carbon atoms, the methods of identification of higher sugar alcohols and the bearing of these discoveries on the configuration of the sugars. There are similar valuable surveys, complete in themselves and covering ground that is already well consolidated but containing much material unfamiliar to the average chemist, on "Carbohydrate Orthoesters", by Eugene Pacsu, on the "Altrose Group of Substances", by Richtmyer, on "Thio- and Seleno-Sugars", by Raymond, on the "Carbohydrate Components of Cardiac Glycosides", by Elderfield, and on the "Chemistry of Nucleic Acids", by Tipson. The papers on "The Fractionation of Starch", by Schoch, and the discussion on "Methods of Research in Plant Polyuronides", are of necessity of the nature of surveys of recent advances. The industrial bearing of carbohydrate chemistry is represented by two articles, by Roy Whistler on the "Preparation and Properties of Starch Esters", and by Charles Fordyce on the "Cellulose Esters of Organic Acids", and the biological aspect by the article of Carr and Krantz on the "Metabolism of Sugar Alcohols and their derivatives". The volume is of undoubted help not only to those specialising in carbohydrate chemistry but also to research workers in other fields. The second volume will be eagerly awaited by all interested in keeping abreast of developments in carbohydrate chemistry.

M. DAMODARAN.

SCIENCE NOTES AND NEWS

ATOMIC ENERGY RESEARCH

Mr. C. Rajagopalachari, Member for Industries and Supplies, Interim Government, recently announced the formation of an Advisory Board for Research in Atomic Energy. He said, "I am glad to announce that a Board of Research in atomic energy has been set up under the auspices of the Council of Scientific and Industrial Research with Professor Bhabha as Chairman. There are large deposits of monazite sand in the Travancore beaches, which is a valuable mineral required for the production of atomic energy. Perhaps the richest thorium ore in the world is to be found in the monazite sands of the Travancore coast. I am glad we have negotiated the agreement by which the mineral conservation policy of the Government of India can be given effect to in this connection.

"We shall have a Joint-Committee consisting of six members of the Board appointed by the Council of Scientific and Industrial Research and three representatives of the Travancore Government. The function of this Joint-Committee will be to advise the two Governments on all matters connected with research and development and the disposal and utilisation of raw material. I am especially glad to be able to announce that this Joint-Committee will be the authoritative advisory body both for the Government of India and for the Government of Travancore, thus bringing this important branch of power research and disposal of raw material into one co-ordinated scheme.

"The Joint-Committee will consist of Prof. H. J. Bhabha (*Chairman*), Prof. Meghnad Saha, Mr. D. N. Wadia, Dr. Nazir Ahmed, Sir K. S. Krishnan, Sir S. S. Bhatnagar, Dr. K. L. Moudgil, Mr. K. P. Menon and Mr. V. Mahadevan.

"I am grateful to Sir C. P. Ramaswami Aiyar, Dewan of Travancore, for the co-operation he has extended in this matter. We had deputed Sir S. S. Bhatnagar and Prof. Bhabha to go to Travancore and discuss matters with him, and the present arrangement is the result of those negotiations. The public may rest assured that the atomic energy resources of India will not be frittered away or go to waste."

MICA RESEARCH

The Travancore Government have entered into an arrangement with the Government of India for the purpose of conjoint research on mineral sands and mica research. They had also entered into certain arrangements with influential British concerns for a joint research and exploitation of the mineral sands of Travancore and production of atomic energy.

MINERAL DEVELOPMENT IN HYDERABAD STATE

Exploratory work to ascertain the occurrence of valuable mineral in different parts of the Nizam's Dominions has commenced under a scheme sanctioned for the expansion of the Mining and Geological Survey Department.

The occurrence of further deposits of coal is being ascertained near the Singareni collieries and Jangaon, and gold development work at Hutti, Lingsoor Taluk, Raichur District, which had been suspended during the war, has been resumed.

Prospecting operations conducted recently in Asifabad Taluk, Adilabad District, are stated to have shown good deposits of clay suitable for manufacturing porcelain ware.

In Khammam Taluk, Warrangal District, prospecting operations have disclosed workable deposits of mica, and regular mining operations are in progress.

In the eastern parts of Paloncha, Warrangal District, abrasive minerals like garnet, alusite and kyanite have been discovered in appreciable quantities and are being leased out.

Corandum, which is a refractory mineral, is also found in abundance in the eastern parts of Paloncha.

PROTECTION FOR FRUIT INDUSTRY

The Government of India has decided to grant protection to the preserved fruits industry for a period of three years.

The Tariff Board, which considers that the industry has been established and conducted on sound business lines, recommended a protective *ad valorem* duty until 1950 of 60 per cent. on canned and bottled fruits ; 40 per cent. on fruit-juices, squashes, cordials and syrups ; and 80 per cent. on jams, jellies, marmalades and candied and crystallised fruits.

RADIO SONDE STATION FOR TRAVANCORE

"Radio-Sonde" station has been established at the Trivandrum Observatory by the Indian Meteorological Department and the first flight was conducted on 25th May 1947 in Trivandrum with a network of fourteen other radiosonde stations distributed all over India.

Radio-sonde is the latest development in meteorological science for the determination of temperature, pressure and humidity of upper atmosphere.

The technique was entirely worked out by the officers of the India Meteorological Department during the last five years, and incorporates many new and ingenious devices, rendering the instrument accurate and reliable and easy of construction, reproduction, installation and operation. The method consists of sending up four-metre wireless transmitters attached to a balloon which sends out regularly signals of pressure, temperature and humidity. These signals are picked up by specially constructed receivers and are recorded on moving paper tape. From these records, the pressure temperature and humidity of air over Trivandrum at various altitudes are calculated.

The data obtained daily are expected to yield

valuable information regarding mechanism of monsoons and, in conjunction with those from fourteen other stations in India, it provides valuable aid to weather prophets at several centres of meteorological offices.

Until recently, before the introduction of radio method, balloons with self-recording instruments were used by the Department for the same purpose.

But, since the success of each flight depends on the chance recovery of the instrument after it falls to the earth, those flights were only of limited use for daily forecasting work. Radio-sonde helps obtain meteorological data at different stations at the same hour, and thus places the science of weather forecasting on a surer basis. The Indian Meteorological Department itself manufactures every part of these instruments, calibrates them, and arranges to send them to different radio-sonde stations set up and run by them.

SNOW SURVEY IN THE HIMALAYAS

The presence of abundant snow water along the high crests of the Himalayas and even at much lower elevations of about 10,000 ft. above the sea level, had been proved. On May 20, the American expert, Dr. J. E. Church, at the Royal Asiatic Society of Bengal, related his experiences of the four expeditions in Sikkim and Nepal that he has carried out during the present spring. Dr. Church added that below that elevation, rivers depended almost wholly upon rains.

Dr. Church who has been invited by the Government of India to lay out a snow survey system in the Himalayas, is Chairman of the International Commission for Snow Survey, U.S.A. He is well known as the originator of the percentage forecast scheme by which the run-off of streams can be estimated in advance directly from the snow fields at the lower elevations. This helps in making a forecast of the volume of water in the great store of snow on high peaks.

The expeditions of Dr. Church this spring in the Sikkim and Nepal regions were in connection with the proposed Kosi and Teesta Dams.

SOVIET EXPEDITION TO THE ARCTIC

The Soviet Union is reported to be planning to sail the first big passenger and transport ships in Arctic waters.

A large air expedition will leave next month to study ice formation in the area and some 200 staff workers of the Arctic Research Institute will work in the Arctic meteorological stations and supply information about ice conditions to ships sailing along the northern routes.

SOVIET FISHING EXPEDITION

A scientific expedition to conduct research into the fishing resources of the seas of Okhotsk and Japan left Leningrad for Sakhalin and the Kurile Islands.

The expedition has four ships at its disposal and it is intended to send at least fifteen parties to various places in this immense area.

TRAINING OF INDIAN STUDENTS ABROAD —SCOPE IN EUROPEAN UNIVERSITIES

Efforts are being made for the higher training of Indian students all over Europe, and, according to latest information, fresh openings for these students are becoming available in most of the European capitals.

Mr. P. N. Kripal, Education Liaison Officer of the Government of India, who has just returned to London from Switzerland, told the United Press of India to-day that he succeeded in obtaining a large number of places in the Swiss Federal Institute of Technology, the Zurich University, and in the College of Engineering, Lausanne. It is expected that some forty to fifty Indan students will be accommodated in the ensuing year.

Mr. Kripal also had good response to his enquiries from Holland, Belgium, Sweden, Czechoslovakia and France. All these countries are said to be very keen on welcoming students from India. In view of the prevailing difficulties of accommodation in London, Mr. Kripal thinks that Indian students would be well advised to attend the continental colleges and try to acquire a rudimentary knowledge of their languages.

VANASPATHI RESEARCH

Two research schemes on Vanaspathi have been sanctioned by the Central Food Department, one to determine the nutritive value of Vanaspati, and the other to determine its effect on human beings.

Research on the first will be conducted at the Indian Institute of Science, Bangalore, and the University College of Science at Calcutta, and research on the second will be carried out at Bombay, Delhi and Mysore or Madras.

Another research scheme sanctioned is in connection with a plant for the manufacture of soya bean milk.

LAUNDRY RESEARCH

New researches in laundering are reported to revolutionise the current methods of laundering. It has been found that dirt is often held to a fabric by electrical attraction. The problem in the removal of dirt from fabrics is to break this electrical attraction; this is done at present by the use of detergents—soap and kindred solutions.

The British Launderers' Research Association is now researching on the use of supersonic vibrations to speed up laundry processes. The function of these supersonic vibrations is to shake out the dirt particles, and emulsify them in the cleansing solution. This will prevent the dirt being deposited again on the fabric.

MACHINE DESTROYS WEEVILS BY DIZZINESS

A Sydney flour milling firm has installed a new machine which cleans flour by spinning weevils or any other insects in the flour to death.

The machine, called an "Entoletor", operates on the centrifugal principle. The flour is fed by chutes into a cabinet housing a conical rotor in the centre of two steel discs joined at the outside by metal studs. Directed on to the revolving rotor, the flour is flung against the

outer studs with such force that no insect, weevil, moth, egg or mite, is left alive. The rotor spins at 2,900 revolutions a minute and a 1½ horse-power machine handles 2,000 lbs. of flour an hour. The 3 h.p. model handles 5,000 lbs. of flour; the 5 h.p. 10,000 lbs., and the 7½ h.p. 15,000 lbs. an hour.

When treated in this way the flour remains sterilised indefinitely and tests have shown that the machine improves the flour by giving it greater aerating qualities.

STEPS TO EXPAND DAIRY TRAINING

The Government of India have appointed an *ad hoc* Committee to study the facilities now available for training in dairying in India, and make recommendation for expansion.

The Committee consists of Sir Datar Singh as Chairman, and the following members:—Mr. Zal R. Kothavala, Dairy Development Adviser to the Government of India, Mr. A. K. Yegna Narayan Aiyer, Retired Director of Agriculture in Mysore, and Dr. Sen, Director of Dairy Research, Bangalore.

CENTRAL GOVERNMENT TO START AN AGRICULTURAL COLLEGE

Detailed plans have now been worked out to start a Central College of Agriculture in Delhi during the current year. The aim of the College will be two-fold, to give a systematic course of scientific agriculture to young men, with a view to preparing them for promoting modern agriculture in the countryside on economic lines, and to train students for undertaking research in agricultural problems.

NEW MEDICAL COLLEGE FOR CALCUTTA

Calcutta will soon have an up-to-date medical college devised to train demobilised licentiate I.A.M.C. Officers for the M.B. and B.S. Degree and a hospital with several divisions, each of which will have its own out-patient department, laboratory, dispensary and wards. The Health Department of the Government of India is establishing this Institution on the Dhakuria Lake site in South Calcutta.

The Central Government have already spent Rs. 85 lakhs for acquiring the site and the equipment for the College and Hospital. The annual recurring expenditure on the College will be Rs. 4·8 lakhs and on the Hospital Rs. 22 lakhs, half of which will be borne by the Bengal Government to whom the management of the College and Hospital has been entrusted.

COLLEGE OF INDIAN MEDICINE

The Madras Government has decided to convert the present School of Indian Medicine, Madras, into a College of Indian Medicine with effect from July 1947.

Arrangements would, however, be made by the Government for the continuance of the studies of those students who are already in the School till their courses are completed.

SOVIET HONOUR FOR SIR C. V. RAMAN

Sir C. V. Raman, President of the Indian Academy of Sciences, has been elected as a corresponding member of the Soviet Academy of Sciences.

NATIONAL INSTITUTE OF SCIENCES

The Academy of Sciences of the U.S.S.R. has presented to the National Institute of Sciences of India 44 books on scientific subjects and 67 copies of journals published by the Academy. The National Institute of Sciences of India has gratefully accepted this welcome gift from a sister scientific body.

LADY TATA MEMORIAL TRUST

(*Scholarships and Grants for the year* 1947-48)

The International awards of the Trust for research in diseases of the blood with special reference to Leucæmias are made to Doctors Jorgen Bichel (Denmark), Pierre Cazal (France), Pierre Dustin (Belgium), Maurice Guerin (France), Simon Iversen (Denmark), Joseph Japa (Poland), Edith Paterson (Great Britain), Edoardo Storti (Italy), Peter A. Gorer (England), Johannes Clemmesen (Denmark), C. F. M. Plum (Denmark), Tage Kemp (Denmark), and Guido Totterman (Finland).

Indian scholarships of Rs. 250 per month each for one year for scientific investigations having a bearing on the alleviation of human suffering are awarded to Messrs. Suprabhat Mukerjee (Calcutta), Haridas Brahmachari (Nagpur), Kalyanmoy Mukerjee (Calcutta), Naresh Chandra Ghosh (Calcutta), P. R. Gupta (Bangalore) and Yeshwant Balkrishna Rangnekar (Bangalore).

A REQUEST

"Those interested in 'problems of theory of numbers especially Diophantische are requested to send their publications to the following address:—Dr. Alfred Moessner, in 13 a, Gunzenhausen (Germany-Bayern), Altes Schulhaus, Amerikanische Zone."

ERRATA

Note entitled "Vernalisation Response of Cultivated Indian Wheat", Vol. 15, No. 12, p. 352: In the names of authors, *read* Pal *for* Paul.

Vol. 16 No. 4, p. 133.—Note on "Proof of the Inverse Square Law and the Measurement of H". Line 8:

for:

$$\tan^2 \theta_A \tan^{3/2}/\phi_B = 2,$$

read:

$$\frac{\tan^2 \phi_A}{\tan^{3/2} \phi_B} = 2$$

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RESEARCH AND EXPLOITATION OF FOREST PRODUCTS

INDUSTRIAL raw materials from land that lend themselves to economic conversion and utilisation by man can be broadly classed as agricultural, sylvicultural and mineral. Agricultural products like cotton, jute, and food crops are receiving considerable attention, and it is expected that comprehensive schemes of research on these will be included in the post-war plans. The sylvicultural products, on the other hand, have not been so favoured, partly because of the unceasing suggestion from all sides that India is mainly an agricultural country and partly because of the neglect in exploring the industrial potentialities of the large variety of raw materials that the country is endowed with. The latest available figures indicate that the surplus forest revenue of India is hardly 26 per cent. as against 35 to 50 per cent. in more technically advanced countries of the West. Of the 400 million people in the country only about a million and a half are employed directly in the collection and distribution of forest raw materials. In independent India we may look forward to a sustained and purposive programme of intensive research and exploitation in this field. It may, therefore, be desirable to outline here a plan for the study and development of industries based on the forest wealth of the country.

The principal products of recognised economic value in Indian forests are timber, fuel, grass, bamboo, sandal and lac. A number of minor products also contribute in a small measure to forest revenue. Investigations carried out at the Forest Research Institutes of Dehra Dun, Coimbatore and a few other centres have no doubt helped in improving the productivity of the forests of India and better exploitation of the forest products with increased financial returns. But the enormous scope for research and exploitation can be gauged by the fact that we have yet to evolve timber trees coming early into maturity, render saplings and timber pest-proof, discover pulp for varieties of paper and rayon; nor have we exhausted the uses or perfected economical methods of production of sandal wood, sandal oil, lac, lac dye, essential oils, gums, resins and grasses.

With regard to timber afforestation following deforestation as a routine practice is all that is mostly being done. Comprehensive, long-term investigations on plant physiology, genetics, hybridisation, forest botany, entomology, mycology and allied branches of sylviculture still remain to be undertaken. Basic and wide knowledge of our national resources are of obvious necessity in turning the forest wealth to greatest advantage. For it is strange that the Indian forests which include practically all types in the world, ranging from dry tropical to Alpine and moist temperate forests, should not be able to supply the right pulp for paper or rayon. While trying, therefore, to induce foreign plants of known utility to grow in our forests, unceasing search must be made for indigenous wood for modern industrial uses. A basic survey coupled with technical progress and sound forestry should certainly promote in increasing measure the use of indigenous pulp.

Sandal culture and utilisation is another instance demanding attention at the hands of both the scientist and industrialist. Sandal wood is a monopoly, particularly of South India, enjoying a very high priority among products of luxury and pharmaceutical value in the world. The income from this source forms a respectable fraction of the forest revenue in Mysore State. The necessity for careful nurture and protection of the plant from pests will be all the more appreciated when it is realised that sandal requires about forty years before it is ready for harvest. But as things stand to-day the annual loss of sandal, especially in the form of saplings as a prey to spike disease, is beyond computation. It is needless to emphasise that an effort in this direction cannot be made too soon. To eliminate or reduce the incidence of the disease, fundamental investigations into the physiology of the host as well as of the virus responsible for the disease are essential. Only such a study is likely to suggest sure methods of tackling the pest. Further, production of sandal oil could also be raised by evolving strains of early maturity and higher oil content. In utilising the oil there could certainly be a more thorough study of its applicability in the pharmaceutical industry. During the last decade a good deal of work was carried out at the Indian Institute of Science on the physiological and biochemical aspects of sandal and its leguminous host plants as well as on the nature of spike disease. With the establishment of the Board of Scientific and Industrial Research in Mysore it is to be hoped that these investigations will be continued towards a fruitful conclusion.

Shellac offers similar and equally extensive scope for both basic and applied research. Shellac is also vulnerable to pests. But in addition, the production is critically influenced by the vagaries of the weather. There have been years when the crop of lac has been cut down to fifty per cent. of the normal production owing to failure of rains. In the early thirties investigations were carried out at the Indian Institute of Science on the nature, production and composition of lac. The Indian Lac Research Institute, Ranchi, has made valuable contributions to our knowledge on the dielectric properties, constitution, effect of storage, etc., of lac. Applied researches on the utilisation of lac derivatives, esterification of rosin with shellac, manufacture of de-waxed lac have also been carried out at this Institute. A good number of industrial applications of lac have been thoroughly investigated by the Imperial Institute, London. We hope that co-ordinated, comprehensive schemes of investigation covering the various aspects of production and utilisation of lac will be continued.

The accepted method of exploiting by-products as a means of cheapening the principal commodity can be applied to lac also. The scarlet dye of the lac insect, which formed the main product in the ancient industry, can find to this day a demand among silk dyers. The dye is not inferior to any of the synthetic products in its sheen or fastness to light. But the drawback is the inconstancy of the shade of the dye extracted from different batches. The immediate demand is, therefore, the working out of methods of quality control in the dye. The washings of the stick-lac, now running to waste in the industry, is also a potentially rich source of nitrogen and vitamins. If we are, therefore, able to work up systematically all the produce of the lac insect, ensure quality in them and press them into service in the national economy of the land, there should indeed be no need to despair of the future of the lac industry.

The forest department is also shouldered with the pressing responsibility of providing a ceaseless supply of fuel to the nation's homes. But the conservators of forests have yet to insist on their right to demand a thrifty and economic use of the fuel which they have to grow with so much pain and care. For it is deplorable that in burning fuel, as we now do, we are able to utilise little more than twenty per cent. of its calorific value. This waste can

hardly be justified when known methods of fuel technology ordinarily followed in coal-burning countries make possible a far less wasteful use of the national supply. It is within the domain of research on forest products to work out ways of conservation of fuel, not only in forests but in the citizen's home, the cumulative value of which will mean an enormous saving of an essential commodity. It is to be hoped that the authorities in charge of forestry will formulate comprehensive plans of investigation on all aspects of the problem and insist on their execution with the same speed as other technical and industrial schemes are favoured with.

EDITORIAL NOTES

MORALITY OF SCIENCE

UNTIL before the atom bomb, Science was considered non-moral. The search for the laws of nature and the knowledge of them was thought to be the right of every one who would seek it. No discrimination in gaining such knowledge and training for further discovery was tolerated. But the burst of the atom bomb on Hiroshima and Nagasaki has suddenly awakened the scientist's conscience and sense of responsibility. It has made him doubt if Science is, after all, outside the purview of human ethics. Prof. Norbert Weiner of the Massachusetts Institute of Technology voiced the opinion of all thinking men when he raised serious objections against freely imparting his findings on controlled missiles. In his letter to a fellow-worker—probably on a war weapon—he questions the current morality of disseminating all knowledge indiscriminately. "In the past, the comity of scholars has made it a custom to furnish scientific information to any person seriously seeking it," writes Prof. Weiner. "However, we must face facts: The policy of the government itself during and after the war, say in the bombing of Hiroshima and Nagasaki, has made it clear that to provide scientific information is not a necessarily innocent act, and may entail the gravest consequences. One, therefore, cannot escape reconsidering the established custom of the scientist to give information to every person who may inquire of him. The interchange of ideas, one of the great traditions of science, must of course receive certain limitations when the scientist becomes an arbiter of life and death.

"The measures taken during the war by our military agencies, in restricting the free intercourse among scientists on related projects or even on the same project, have gone so far that it is clear that if continued in time of peace this policy will lead to the total irresponsibility of the scientist, and ultimately to the death of science. Both of these are disastrous for our civilisation and entail grave and immediate peril for the public."

Continuing, the professor writes, "The experience of the scientists who have worked on the atomic bomb has indicated that in any investigation of this kind the scientist ends by putting unlimited powers in the hands of the people whom he is least inclined to trust with their use. If, therefore, I do not desire to participate in the bombing or poisoning of defenceless peoples—and I most sincerely do not—I must take a serious responsibility as to those to whom I disclose my scientific ideas."

These contentions of Prof. Weiner and men like him—who are many—strongly remind us of the age-old Hindu precept which enjoins the *Guru* to be careful, circumspect and severely strict in choosing his successor who will be called upon to carry forward the torch of Knowledge. And to-day we are driven to think on almost exactly similar lines, that all men could not be trusted with the power for evil.

The importance of psychological fitness for the respective professions is being increasingly recognised. In this era of the atom bomb, therefore, a huge responsibility devolves on the scientist in imparting to the world at large new scientific information, especially information of the kind likely to be misused as a weapon of war. It is clear that the profession of science can only be entrusted to those who entertain such an abhorence of war and human suffering that they would rather sacrifice science as a career than co-operate with the war-monger in any form. Another and more practical way of preventing the abuse of science is for the scientists, as a class, to refuse, in the words of Sir J. C. Ghosh, to be the camp followers of politicians. We trust the urgent realisation of the gruesome consequences of the use of the atom bomb will swell the volume of opinion in favour of humane and rational science taking the lead in the management of world affairs. For it is abundantly clear that current politics has woefully failed to keep pace with the progress of science which has broken barriers and erased man-made frontiers. We wish the Atomic Scientists, led by Professor Einstein, every success in their efforts to rationalise the application of science for the promotion of human happiness.

FACTORY TRAINING FOR INDIAN STUDENTS OVERSEAS

WE are receiving repeated complaints from our scholars in the United Kingdom and United States that facilities for practical training are lacking in both the countries. While the universities and technical schools have extended a warm welcome to Indian students, the factories and industrial plants have failed to encourage them. Mr. Krishnamurti from Akron, Ohio, writes in a letter to *The Hindu*, "With great difficulty I was able to arrange and complete three months' training in the Firestone Tyre Company ... I have been trying to arrange for further practical instruction,

but so far no company is prepared to take me in. This is the fate of many other Government scholars in this country. It is time that the Government did something in regard to arranging for practical training."

The situation is not much different in U.K. Last April at the National Union of Students' Congress, held in Liverpool, both Indian and other foreign students protested against the ban on the admission of non-British students to certain factories in Britain. Mr. Marshall of the Metropolitan Vickers, regretting the ban as unfortunate, said that it was a Government ruling and could not be helped. The ruling appears, to say the least, rather anomalous when viewed in the light of the generous invitations of the British Government to India to take advantage of the facilities for Technical training in Great Britain. And it is well known that we are seeking the co-operation of the technically advanced countries more for the benefit of practical training of our students in industries not yet established in India rather than for high academic accomplishments. We learn that the Chinese Government have been able to negotiate with a number of industrial firms in America for entertaining their students. The extension of similar hospitality to India by Britain and U.S.A. at a time when it is most needed will be a friendly gesture that is bound to be greatly appreciated.

LABORATORY TECHNICIANS

We are informed that the Council for Technical Education has appointed an Expert Committee to consider the subject of training laboratory technicians and submit concrete proposals for a comprehensive scheme. All scientific workers will agree that such a scheme of training has been long overdue in this country.

As conditions obtain at present, much of the valuable time of the research worker is spent in getting ready the routine apparatus and reagents required for his specialised experiment which will perhaps occupy only a fraction of the time he had to spend on the preliminaries. No doubt advanced and elderly workers can command their students to do these for them. But it will be realised that the students, although they must go through this mill for their own good, are not exactly meant for this job. The result of all this is the unnecessary overworking of the scientist and an obvious slowing down of the pace of scientific research.

On the other hand, in the advanced laboratories of the West the scientist need only confine himself to the working out of the precisely specific problem of research he has set himself to accomplish. The trained laboratory technician cleans the apparatus, prepares the reagents, does the weighings, cuts sections, carries out simple glass-blowing, recovery-distillations, etc., as per the instructions of the research worker, leaving him more time for the essential library and laboratory work. No wonder, therefore, that both the quality and quantity of scientific work turned out by such workers easily excel that of the worker who has to be a mere hack. The need for training large numbers of technicians is all the more pressing in view of the very limited research talent in the country which must be strictly rationed out and devoted to tasks that only trained scientists can do.

A word for the technician himself. Recently Prof. Haldane mentioned that many a young man starting as a laboratory technician has graduated himself to eminent chairs of science in European and American Universities. This speaks not only of the potentialities of some of the people who are compelled by circumstances and natural accidents of life to start from the lowest rung of the ladder but of the generous universities who are always on the alert to exploit scientific talent wherever it is to be found. We are sure that the experts on the Committee will so formulate the scheme of training that opportunities for training oneself as an original investigator are not wanting for those technicians who have it in them to develop into good scientists.

The dearth of laboratory technicians is now so great and the need for a continuous supply of them will be so persistent that it would be advisable for large institutions to establish a standard course to be recommended by the expert Committee as a regular feature among their courses of training. Men so trained, it is needless to say, will be readily absorbed by industrial, technical and public health laboratories as well as by universities and research institutions to the obvious benefit of all.

WATUMULL RESEARCH FELLOWSHIPS

The Watumull Foundation announces the award of ten Watumull Research Fellowships in Indian Universities to the following candidates: —*Agriculture*: Mr. O. N. Mehrotra, J.K. Fellow, College of Agricultural Research, Benares Hindu University; and Mr. K. M. Shahani, Imperial Dairy Research Institute, Bangalore. *Education*: Mrs. Leelavati M. Rao, Child Education and Psychology, Allahabad University; and Mr. L. J. Bhatt, Lecturer in Education and Psychology, Teachers' Training College, Baroda. *Chemistry*: Mr. Jyotirmoy Bhattacharya, Demonstrator, Applied Chemistry, Science College, Calcutta. *Economics*: Mr. Premchand Srivastava, Lecturer in Economy, Jain College, Arrah, U.P. *Political Science*: Mr. K. L. Srivatsava, Professor of Politics, Christian College, Indore. *Physics*: Mr. Biswanath Bhattacharya, Benares Hindu University. *Medicine*: Dr. D. R. Nagpal, Lady Linlithgow Sanatorium, Kasauli. *Mathematics*: Prof. Surya Prakash, Professor of Mathematics, Herbert College, Kotah (Rajputana).

PALÆONTOLOGY AND THE MEASUREMENT OF GEOLOGICAL TIME

Comments and Suggestions for a Plan of Research by the Committee on the Measurement of Geological Time in India*

B. SAHNI, SC.D., F.G.S., F.R.S.

(*Professor of Botany and Director, Institute of Palæobotanical Research, Lucknow*)

(A) INTRODUCTION

AMONG the many useful activities of the Department of Scientific and Industrial Research at New Delhi, under the directorship of Sir Shanti Bhatnagar, F.R.S., one of the most interesting promises to be the work of the newly formed Committee on the Measurement of Geological Time.

A palæontologist can here be of assistance only indirectly, because fossils can at best give only a relative measure of Time. But I appreciate the honour of being asked to work on this Committee, for I realise that in these investigations a concerted plan of action can help to make the approach more rational, and, in any case, a palæontological check may be found desirable.

A perusal of the valuable Memorandum issued jointly by Professor M. N. Saha, F.R.S., and Mr. Wadia[1] suggests the following comments as to the place which palæontology can occupy in such a scheme of research.

(B) POSSIBILITIES OF THE PALÆONTOLOGICAL APPROACH

The strata of the earth's crust were at first recognised only by their lithological characters. Their relative ages could be known only by their order of superposition as observed in the field. Later it was discovered that they could be more reliably identified by their contained organic remains which on the whole, and in a general way, were found to be characteristic of them even where the lithology was not the same. Gradually it was realised that fossils were important landmarks of organic evolution and, therefore, of geological history. Now they are our trusted guides to geological age, dependable even in new and distant regions of the world, and in areas of disturbed stratigraphy. They are particularly reliable when considered in their natural assemblages in the strata, that is, as floras and faunas. With the close study of morphological variations palæontology is growing into a fine science; it has already made possible a zonal subdivision of the strata which occasionally reaches a surprising degree of minuteness and accuracy, and is applicable over wide areas.

Except for a few apparent discrepancies which can be explained away, the facts of palæontology have given consistent results for dating the rocks.

The question still remains whether two floras or faunas of similar composition in distant parts of the globe are strictly contemporaneous. But as it seems that the rate of dispersal of species is far more rapid than the rate of their extinction, geologists generally accept homotaxial strata as being practically of the same age.

Latterly the microfossil investigation of sediments has come to the aid of the stratigrapher and this aspect of palæontology finds increasing application in explorations for oil and coal, where a close knowledge of the stratigraphical sequence is important. We now know that not all sedimentary formations which outwardly appeared to be unfossiliferous are really devoid of organic remains. Some of these have recently been shown to be astonishingly rich in microfossils representing both plant and animal groups. The Saline Series in the Salt Range of the Punjab is a good case in point;[2] so also the glacial tillites at the base of the Gondwana system in Australia[3] and South Africa[4]—and quite recently organic remains have also been detected in the Talchir Boulder Bed near Chittidil in the Salt Range.[5] Owing to their wide dissemination in the body of the rock-matrix microfossils can sometimes provide an age index even if small bits of the rock collected at random are analysed.[6]

Experience suggests that, barring the most ancient sedimentary formations (Silurian or older), all freshwater beds and even marine shallow water deposits may now be expected to reveal plant microfossils, provided they have not undergone serious metamorphism.

In metamorphosed sediments the megafossils are generally too badly obliterated to be of much use to the palæontologist. It would be interesting to enquire as to whether the microfossils in such rocks can escape obliteration. Metamorphosed shales bearing deformed leaf-impressions should be put to the microfossil test.

There are great areas in India, particularly in the Peninsula, covered by ancient sedimentary rocks of unknown or disputed age. Very few megafossils have been found in these strata, nor are we likely to find many more in the future. An attempt may usefully be made to recover microfossils from samples of these rocks which should be collected from localities and horizons by geologists who best know the areas.

Igneous intrusions are known to traverse some of these rocks of doubtful age. It has been suggested by Professor Saha and Mr. Wadia that a systematic examination should be undertaken of the radio-active content of the minerals in these intrusive rocks. If any recognisable microfossils are found in the associated sedimentaries, and if their age can be even broadly estimated, we shall at least have a maximum age limit for the intrusives, for these cannot be older than the sediments into which they were injected.

(C) LIMITATIONS

But with all this, the limitations of the palæontological method must be recognised. Palæontology, even at its best, can give us only a relative measure of the ages of strata. Very

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little is at present known of the rate at which new species arise, disperse through space, become modified or extinct, and are eventually replaced by others in the course of evolution. Nor is it to be expected that the tempo of evolution has been uniform under all conditions, even for the same species. These intricate phenomena are determined by a network of factors relating to the response of living beings to an ever-changing physical background.

The palæontologist, moreover, is helpless in dealing with rocks which are unfossiliferous; and there are other circumstances, only too familiar to those who have to deal with fossil fragments, which limit our power of estimating the age of a flora or fauna.

For anything like an absolute measure of Time we must have resort to physical methods of investigation—mainly, it seems, to a radioactive determination of the minerals composing the rocks (except in the case of varved Pleistocene sediments which can be exactly dated by counting backwards as shown by De Geer and his school and certain other beds, like those at Oeningen, in which, again, seasonal variations can be detected). But the physical approach also has its limitations. For one thing, the radio-active method is only applicable to certain types of rocks.

(D) Need for a Concerted Plan of Investigation

Obviously, therefore, the problem of the Measurement of Geological Time can best be handled by a concerted plan of action. While it is clear that the main line of attack must be physical, a palæontological check can be of considerable use, and in the initial stages of investigation may save much groping in the dark. We can at once appreciate this fact from the known history of the discussions which ultimately led to the present broad agreement between physicists and geologists upon the question of the age of the earth.

For example, when dealing with interstratified sedimentary and volcanic rocks, or where igneous intrusions traverse sedimentary strata of unknown age, it may be possible to determine the approximate age of the sedimentary beds palæontologically before the physicist, with his more exact methods, attempts to arrive at precise results. This aspect is more fully dealt with below, with reference to the Deccan lavas and some other volcanic rocks in India.

Normally, we should expect geophysics and palæontology to give concordant results. Any large disagreement would suggest a more critical examination of the evidence from both sides. This should give us a clearer insight into the relative value of the two modes of attack, and help to dispel exaggerated notions concerning the reliability of a particular kind of evidence.

(E) Suggested Lines of Investigation (*Mainly Palæobotanical*)

At the present moment the following aspects of the problem appear to the writer to be worthy of investigation from the palæontological (mainly palæobotanical) side.

(*a*) *Microfossil investigation of Indian sedimentary deposits of unknown or disputed age, some of which are traversed by intrusive igneous rocks.*

(*i*) *The Cuddapah, Vindhyan and other formations in the Indian Peninsula, and the Purple Sandstone in the Salt Range.* In a brief note just published, J. Hsü[7] records an attempt to obtain microfossils from the Purple Sandstone at Khewra, which is generally accepted as Lower Cambrian but which some geologists have placed in the Tertiary. Tertiary sediments generally yield some clear evidence of vascular plants, such as shreds of wood, spores or pollen, or the chitinous remains of highly evolved insects. Hsü failed to discover any such fossils in the Purple Sandstone, thereby indirectly supporting the idea that the Sandstone is a very ancient deposit, dating back to a time prior to the origin of vascular land plants, or of the winged insects. Similar investigations might usefully be extended to the Cuddapah, Vindhyan and other presumably ancient sediments.

(*ii*) *Various pre-Carboniferous sedimentaries in the Himalayas whose age is open to doubt.* In the Kashmir-Hazara region, and extending north towards the Pamir plateau, D. N. Wadia has recorded the occurrence of land conditions during a long period of the Early Palaeozoic. From the Central Himalayas, Hayden, von Krafft, Griesbach, La Touche and others have collected rocks of ages variously reported as Ordovician and Silurian, some of which contain plant remains. All such occurrences of plants in strata of ancient date would well repay critical examination. In some of these specimens there are clear signs of vascular plants suggesting members of one of the earliest groups of land plants that we know, namely, the Psilophytales. This material is being examined by the writer through the courtesy of the Geological Survey of India, but more extensive collections need to be made, and each collection examined separately, horizon-wise, both for its microfossils and megafossils. We may thus obtain data of some chronological interest concerning a part of the geological scale which has so far yielded very little fossil information in this country.

(*iii*) *Strata in the Poonch State and adjoining areas* which Wadia[8] correlates, probably correctly, with the Lower Gondwanas, but in which no fossils have yet been found. These may on microscopic examination yield spores similar to those discovered in carbonaceous Lower Gondwana shales in the Peninsula and in the Salt Range, and thereby confirm the suggested correlation.

(*iv*) *The Upper Gondwanas of the Coromandel Coast,* which L. F. Spath[9] is inclined to regard as Cretaceous, may be worthy of a closer attention than has yet been bestowed upon them. A microfossil analysis would very probably show them to be of Jurassic age. Some Upper Gondwana rock-samples from Tabbowa in N.W. Ceylon, on other grounds regarded as Jurassic, and probably contemporaneous with the Madras coast Gondwanas, yielded a rich microflora of Bennettitalean cuticles and coniferous woods, giving a clear verdict in favour of a Jurassic age.[10] The island of Ceylon is generally thought to be a region particularly poor in organic remains. But there is good reason to believe that with the microfossil method a very rich fossil flora can be brought to light in the Mesozoic sediments of Ceylon.

(v) *Certain beds in the Solan-Simla area and in the Kosi area of Eastern Nepal* of which the age is uncertain but which are now provisionally correlated with the Talchir Boulder Bed, may usefully be searched for microfossils. With the discoveries, recently made, of microfossils in the Gondwana tillites in Australia, S. Africa and the Salt Range,[5] it should be possible to demonstrate the correctness or otherwise of the suggested correlation of the Blaini[18] and other beds in these areas with the Upper Carboniferous, by subjecting rock samples (particularly the shaly and dolomitic rocks within the Blaini beds) to the same technique. The Infra-Krol Series may also reveal spores comparable with those of the Lower Gondwana shales in the Peninsula and in the Salt Range. Some rock samples kindly sent to me by Dr. West and Mr. Auden are awaiting examination.

(β) *Age-levels of different horizons of the Deccan Trap lava pile.*

The writer has for several years been publishing fossil evidence to show that the Deccan Traps are Tertiary, and that the whole of the eruptive period in the Deccan was probably only a brief episode within the Eocene.[11] This idea needs to be checked both by palæontologists and physicists. Palæontologically this can be done by making a more intensive and extensive search for fossils throughout the Intertrappean series from its presumed base in the Nagpur-Chhindwara and in the Rajahmundry areas to its top along the Bombay coast. The results should be compared with geophysical age estimates of different horizons in the volcanic series.

The flora (and fauna) from each easily accessible intertrappean bed should be examexamined strictly on its own, and a comparison of the whole series from top to bottom should be undertaken to see if there is any large evolutionary change, apart from local facies differences which have been already demonstrated and commented upon in papers by the writer and his co-workers.

It has been suggested by geologists that the middle part of the Deccan Trap series lacks fossiliferous intercalations. This idea seems to need careful scrutiny; with the microtechnique now at our disposal even a thin layer of dust definitely known to belong to an Intertrappean interval may yield microfossil material. All junctions between successive lava flows, wherever easily accessible, should be carefully examined for freshwater intercalations, however thin; and the red bole found in the region of Poona should be micro-analysed.*

(γ) *Age of the Khewra Trap in the Salt Range.*

Recent discoveries of microfossils in the Saline Series of the Punjab Salt Range show a post-Cambrian age for the Series;[12] this fact, considered with the stratigraphical relations of the beds, goes to prove that the Series is Eocene, as first suggested long ago by Koken and Noetling. *If the Khewra Trap is definitely a contemporaneous lava flow and not a subsequent intrusion*, even a rough lead-ratio analysis of the trap rock should give a clear verdict, because the alternatives are so far apart (something like 60 or 70 million years for the Eocene; and about ten times that figure for the early Cambrian—even a higher figure for the pre-Cambrian). If the object is merely to decide between these two ages the physicist can even afford to include in his calculations any non-radiogenic lead that the Trap may contain.

Fresh, unweathered samples of the Khewra Trap have been sent for analysis to Professor A. C. Lane of Harvard but the result is still awaited.*

(δ) *Age of the* Cardita beaumonti *Beds.*

These beds have commonly been regarded by Indian geologists as Upper Cretaceous, mainly, it seems, on the strength of the "species" known as *Cardita* (*Venericardia*) *beaumonti* founded by D'Archiac and Haime. It has been suggested by Rutsch[13] that this specific name covers a series of closely related forms varying in age from late Cretaceous to early Tertiary. Obviously, therefore, the Indian form or forms should be subjected to a critical re-examination. I have elsewhere[14] sounded a warning that a new species thus founded on material from a fresh area should not without further reasons be accepted as an age index.

The question is of some importance in relation to the debated age of the Deccan Trap. A radio-active analysis of the associated igneous rocks may be helpful but it is important first to ascertain whether these igneous rocks really represent a lava flow or only an intrusive sheet; so far as we know this all-important question has not yet been decided, though much speculation has been indulged in upon the relation of these igneous occurrences with the true Deccan Traps of the Peninsula.

A microfossil analysis of the sedimentary beds may throw some light upon their age if parallel data are also collected from strata of known Upper Cretaceous and Eocene age. We have at present very little information concerning the microstructure of arthropod chitins and on the minute structure of animal shells. It is possible that a close comparison of these skeletal parts under the microscope will reveal specific and even generic differences between forms too readily accepted as identical. The suggestion is not unwarranted, for we have ample experience of this sort from the plant world. It is beyond our scope here to suggest a large-scale investigation of all sorts of animal chitins, living and fossil, on the lines of work now in progress in many parts of the world on spores, cuticles and woody tissues of plants, which have yielded fruitful results in the classification of fossil plant fragments. But comprehensive micropalæontological investigations on the lines indicated would seem to contain great promise of results which should be of value to the stratigraphical geologist,

* Specimens of the bole are being examined at my suggestion by Professor K. V. Kelkar of the Geology Department, Fergusson College, Poona.

* On the retirement of Professor Lane, recently, Dr. John Putnam Marble, Chairman of the Committee on the Measurement of Geological Time under the National Research Council of Washington, has very kindly agreed to help. This offer of co-operation is deeply appreciated.

quite apart from their intrinsic interest in the taxonomy of animals. Many fossil forms identified by their general features are likely to prove distinct if examined more minutely. *Lingula ovalis* has for many years been cited as a remarkable case of persistence of type from the Early Palaeozoic down to the present day. The writer finds it hard to believe that this presumed (and widely accepted) identity between the ancient form and the modern would stand the test of scrutiny under the microscope.

(*c*) *Geochronology of the Pleistocene of Kashmir.*

There is a wide and fascinating field, largely untapped, for research in India on the lines laid down in the classical work of Baron de Geer and his school in Scandinavia, North America and other parts of the world.[15] The Karewas of Kashmir contain numerous outcrops of varved clays which would well repay examination. A whole team of field geologists can be employed in making, firstly, a general survey of all such occurrences, then a series of collections of varved columns which should be combined into a local chronological scale. It may ultimately be possible to make detailed correlations with the glacial and interglacial cycles in Scandinavia. The palaeobotanist can help to complete the ecological picture by working out the pollen flora in the varved sediments, which should indicate local changes in vegetation and climate.[16] The important work of Dainelli, de Terra, Norin and others on the Pleistocene of Kashmir is a clear indication of the possibilities that lie before the Indian worker: obviously this is mainly a task for those who can apply themselves continuously to field work for some years at a stretch.

A considerable amount of work has been done by Puri[17] on the larger plant-remains in the Karewas. This work should be brought to completion, but at the same time it should be recognised that the pollen analysis of the Karewa Series, and of the sub-recent peat deposits of Kashmir, holds promise of even richer results for a close dating of climatic oscillations and orogenic movements in this area during the past few million years.

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INDIAN WOOL*

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ON account of its many scientific and technical aspects, wool has been a subject of close study in recent times. As a result we have a fairly good conception of the physical and chemical nature of wool, one of the oldest known protein fibres; and the knowledge has been fruitfully utilised in a number of technological developments pertaining to woollen textile industry. From the economic standpoint the quality of wool is of paramount importance to the country which has a large trade in this commodity. Assessment of wool qualities in terms which are physically definable is, therefore, necessary. This is generally done either by specific numbers or by some symbols which show a relation to the spinning quality expressed as "Counts". Ultimately, however, all such specifications which are made by the wool sorters merely by appearance and feel of the samples, are related to the absolute dimen-

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sion of the fineness of the fibres which is precisely measurable in physical terms. Laboratory methods have been, therefore, perfected and specifications drawn up to which various trade qualities of wool conform.

Indian and Foreign Wool

Of the four thousand million pounds of wool annually produced in the world, the major proportions are contributed by Australia and New Zealand (33 per cent.), and by America (25 per cent.). The European countries produce about 20 per cent., while Africa and Asia account for the rest almost equally (10 to 12 per cent.) between them.

India produces annually nearly one hundred million pounds of wool, which is 2·5 per cent. of the total world production, and is valued at fifty to sixty million rupees. Of this about half is exported, mostly for the manufacture of carpets. But, like cotton, Indian wool, in common with other Asiatic wools, is considerably coarser than those produced in other countries, notably Australia. Indian wool, consumed in this country and abroad, is useful only for coarse quality goods such as blankets, carpets, cheaper qualities of felts and as a lining material for clothings made from finer wools. Indian woollen mills, producing yarns and cloth for the worsted and clothing types of materials, mostly use foreign wools or blends of foreign and Indian wool of selected varieties from Kashmir and Tibet.

On the other hand, paradoxical as it may seem, India also produces the world's finest wool material, namely, the undercoat of fine hair of the famous Pashmina goat of the Kashmir frontier. The production of Pashmina wool is, however, extremely limited, and the question of increasing the population of this animal in its own habitat and in other parts of the country still needs a systematic investigation.

As the finer quality wools consumed by the woollen mills costing 10 million rupees and the fabric materials costing nearly 30 million rupees, are all imported the question may be asked, if it is not possible to produce better wool in this country. Before attempting to answer this question it is important to know the types of wool produced in India and their comparison with the foreign products. The following table gives the relevant information.

Fineness, Homogeneity, Medullation and Length

Fibre fineness is the main characteristic which determines the quality of wool, and it would be seen from the foregoing table that the first and second quality wools from other countries with finer fibres are much superior to Indian wools. However, as far as the fineness is concerned foreign wools of the coarser types (third and fourth qualities) are comparable with the two higher grades of Indian wool (Joria and Bikaner). Still, foreign wools with the same fineness as these two would be rated at a much higher value by the wool trader. Coarseness of the fibre is, therefore, not the only defect in Indian wool. It is the very uneven spread or distribution of the fineness, combined with what is known as medullation or hairy portion, indicated by the dead white appearance and non-resilient nature of the fibre that are responsible for the inferiority of the Indian wool. These defects result from the wild state in which the Indian sheep are allowed to breed. In the absence of selective breeding, they propagate their primitive coat of coarse hairy wool from generation to generation, without any improvement. This fibre heterogeneity and medullation are noticeable in some foreign breeds of sheep also, such as the Romney of New Zealand and the Blackface mountain sheep of Scotland, but these are rather exceptional cases, whereas in most of the Asiatic breeds both heterogeneity and medullation are common.

Commercial Classes of Wool in Various Countries

Wool type	Trade quality	Fineness (fibre diameter in microns)
INDIAN ;		
(i) Joria	40's	38
(ii) Bikaner	36's	40
(iii) Low East Indian	very low below 30's	50
AUSTRALIAN ;		
(i) Super combings (Merino)	80's	19
(ii) ,, clothing	70's	20
(iii) ,, cross bred	58's	26
(iv) Cross bred	46's	35
S. AFRICAN		
(i) Super combing	80's	19
(ii) Second combing	66's	21·5
(iii) Coarse merino	below 60's	Above 24
AMERICAN		
(i) Fine	80's–64's	19–22
(ii) Half blood	60's–56's	24–28
(iii) Quarter blood	50's–46's	31–35
(iv) Common bred	44's–38's	37 39
ENGLISH :		
(i) Southdown	58's–50's	26–31
(ii) Cheviot hog	44's–40's	36–38
(iii) Scotch black face	32's–28's	48–52

It would be, therefore, obvious that unlike foreign wools, specifications giving only the fibre fineness would not suffice for Indian wools. We need to have specifications for heterogeneity and medullation as well. These have to be established by suitable methods, heterogeneity by the evaluation of the co-efficient of variation in diameter from a large number of microscopic measurements on the individual fibres in a wool sample and medullation by the measurement of the medullated portions in each fibre, carried out along with the diameter measurements.

A clear idea of the position being considered would be obtained from the accompanying diagrams and photographs. Figs. 1, 2 and 3 show instances of homogeneous, moderately homogeneous and heterogeneous fibre distributions respectively in samples of shoulder wool from three different sheep. While Fig. 1 shows a uniform sample with high peak, the large variations in fineness (diameter) and the con-

sequent heterogeneity of the sample in Fig. 3 is at once apparent. Most of the Indian wool

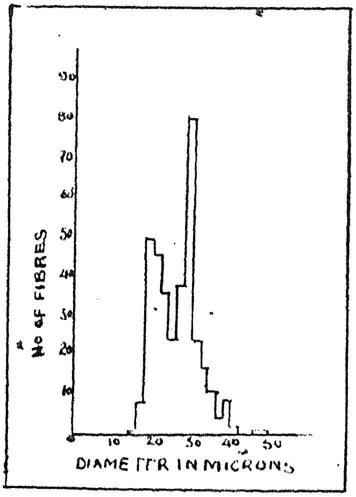


Fig. 1

is of this character, and this is conveniently shown by the corresponding value for the per-

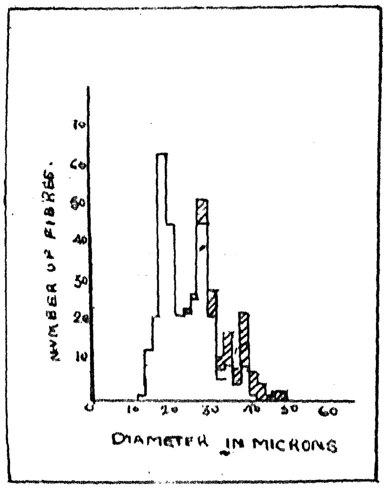


Fig. 2

centage coefficient of variation in diameter, designated as C.V. The proportion of medul-

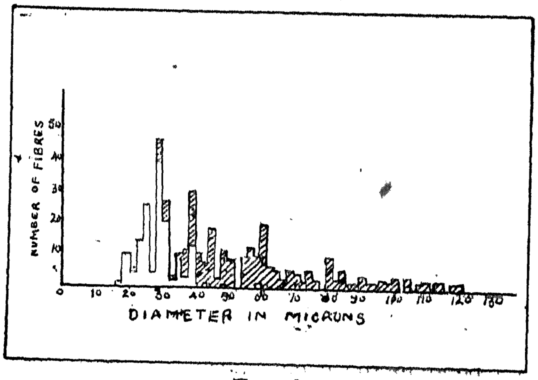


Fig. 3

lated or hairy fibres and their distribution is also shown in Figs. 2 and 3 by the shaded portions. Fine wool of Fig. 1 has no medullation. Photomicrograph in Fig. 4 shows wool fibres with clearly visible outer covering of scales. These are fine wool fibres free from medullation. The sample in Fig. 5 is a heterogeneous mixture of fine and coarse fibres. Such specimens have very high C.V. figures giving values above 50 per cent. Fig. 6 shows a very inferior type of wool, almost wholly hairy or medullated and very coarse.

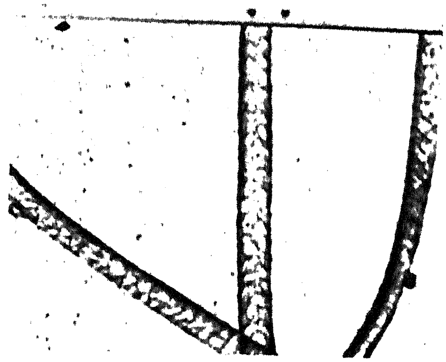


Fig. 4

Cross-sectional views of wool samples are still more helpful in arriving at an estimate of the wool quality, as all the necessary features—fineness, homogeneity and medullation—are strikingly brought out in one picture. Some

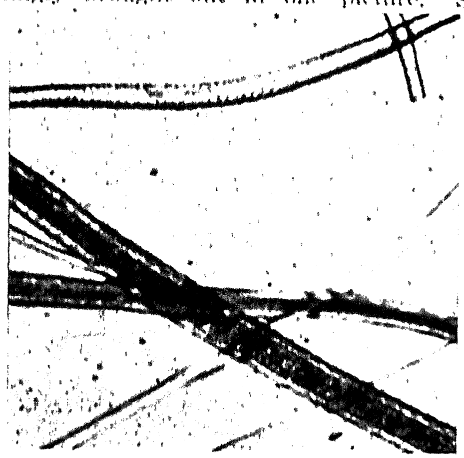


Fig. 5

typical cases are shown in photomicrograph Figs. 7 to 10. Fig. 7 is fine Merino wool, homogeneous with uniform fibre diameters and totally free from medullation. Fig. 8 shows the cross-section of a sample of Kashmir wool, coarser than Merino, but free from the defects of heterogeneity and medullation. Fig. 9 is a wool sample with none too homogeneous distribution of fibres. Medullation is marked in coarser fibres as central dark spots. Fig. 10 shows very coarse fibres—almost all hair, high-

ly medullated. As the photographs are obtained at the same magnification (× 110) the cross-

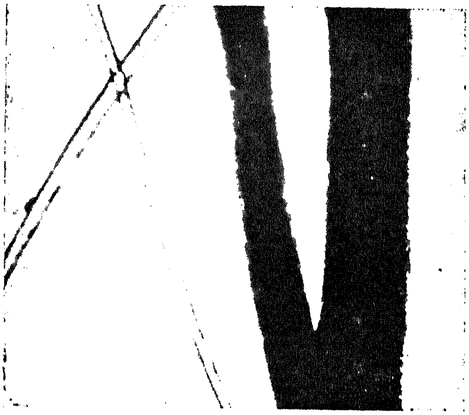


Fig. 6

sections give a good idea of the relative fineness of each type of wool. (Scale: 1 cm. = 90 microns.)

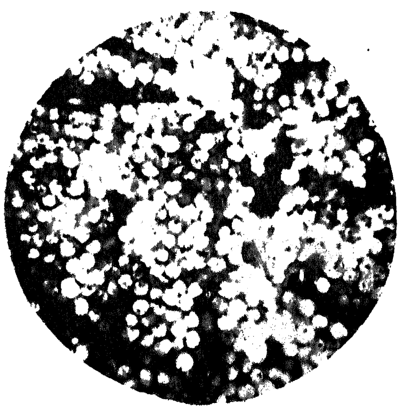


Fig. 7

A high coefficient of variation in diameter, with values above 40% and medullation above

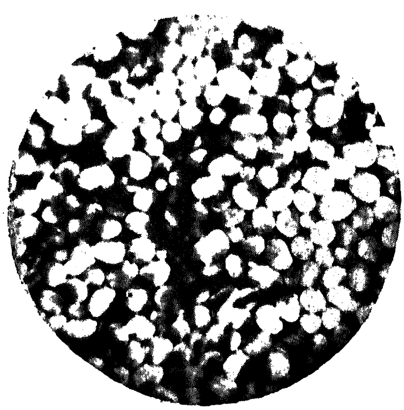


Fig. 8

30% definitely imparts a coarse and harsh feel to the wool sample under test, so much so that it is possible to lay down a quality scale of wool in accordance with the magnitude of these

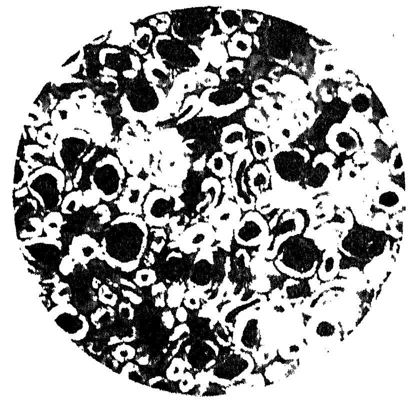


Fig. 9

defects. It would be thus apparent that assessment of any sample for its spinning qualities based solely on its average fibre fineness would lead to erroneous results, if heterogeneity and

Fig. 10

medullation are left out of consideration. On the other hand with foreign wool this difficulty is not at all serious, and a direct correlation between the fibre fineness and spinning quality expressed as 'count' numbers has been laid down as shown in the following table.

The trader's specification of wool qualities is generally in terms of the count numbers mentioned here, which indicate the number of hanks, each 560 yards long, which could be spun from 1 lb. weight of wool. As the length of the yarn which could be obtained from a given weight of the fibrous material depends on the fineness of the individual fibres the practical advantage of this system of quality specification is obvious. It is similar to that adopted for cotton (840 yards in a hank). Judged from their average fibre-fineness values only the better types of commercial Indian wools like Joria and the Bikaner would hard-

ly be above the 50 count quality, though they are never assessed in these terms, for their extreme heterogeneity would considerably lower down this count values below 40.

Spinner's count	Fineness (Diameter in microns)
100	17·1
90	18·3
80	19·6
70	20·8
64	22·3
60	23·4
58	25·5
56	27·2
54	29·0
50	31·0
48	33·1
46	35·5
40	38·3
36	39·2

The length of the staple, so important for the cotton spinner, is also significant for wool as far as the manufacture of yarns for the worsted and finer clothing industries are concerned. Finer wools are generally short (2 inches), while the coarser varieties of non-medullated wool are obtainable in lengths upto 8-10 inches or more. However, for the medullated hairy type, length could be indefinite. As a matter of fact long hairy fibres are unsuitable for carpet and blanket manufacture and for this reason Indian wool with at least two shearings in a year (*Chaitra* and *Shravana*) in March (Spring) and September-October (Autumn), is not generally allowed to grow to a length of more than 3 inches. The climatic condition of the country also makes it necessary to have two shearings in a year.

Foreign Matter

Raw wool on the body of sheep is always contaminated with grease known as wool-fat, and suint or perspiration matters. Together with these natural accompaniments, vegetable matters and burrs, dirt and refuse also accumulate on the body, and are very often allowed to go to the market with the sheared wool collections. Even deliberate adulteration of dirt is resorted to in order to increase the apparent weight of wool, so that a given quantity may fetch a higher price than the non-adulterated lot. This ruse may or may not be successful but it certainly leads to heavier transportation charges and creates a bad impression in the public mind about the unclean nature of Indian wool. Such a practice together with the bad sorting for which Indian wool is known may, on the other hand, hit the producer and seller like a boomerang, for they may actually realise a higher price if it is based on what is known as the yield value, or the percentage weight of clean wool which could be obtained after it has been subjected to a thorough scouring process.

Scoured wool is seldom offered for sale, but sheep are generally washed before shearing. Even where the scouring practice is adopted the use is often made of cheap alkaline soap which tends to make wool felted and impart to it a harsh feel. In any case there is the necessity of marketing wool of any type only after its clean-scoured yield has been determined according to a standard method. The prices should then be based on: (1) the general qualities of the fibres and (2) the clean scoured yield. This procedure is followed in other countries. Reference cards are prepared for wool merchants showing at a glance the prices of each type of wool corresponding to all possible yield values. It is interesting to note in this connection that one of the progressive Indian States recently carried out an experiment on marketing well-sorted and scoured wool, which fetched a price 25 per cent. higher over the unwashed wool for the same variety, after deducting all the costs involved in the extra operations. The advantage of introducing standard methods of scouring and sorting is apparent.

Wool Production and Marketing

The annual production of wool in different parts of the country according to the 1940 figures is shown in the following table.

Annual Production of Wool in India

Area	Number of sheep (lakhs)	Annual yield of wool per sheep (greasy basis) lb.	Annual production of wool (lakh lb.)	Percentage to total production
Kashmir State ..	12·5	1·5	18·5	2·2
North-west Frontier Province including Agency and Tribal areas	8·4	3·4	28·3	3·3
Br. Baluchistan States	15·1	3·2	48·6	5·7
Sind and Khairpur State	7·8	4·0	30·9	3·6
Punjab	44·2	3·8	169·7	20·0
Punjab States ..	13·6	3·8	52·3	6·2
United Provinces and States	22·0	4·3	75·1	11·2
Rajputana States	53·2	3·1	164·5	19·3
Western India States ..	12·5	3·7	46·3	5·4
Bombay including Deccan States	21·1	1·0	21·1	2·5
Mysore State	26·0	0·85	22·1	2·6
Madras and States ..	121·9	0·56	69·4	8·2
Hyderabad State ..	59·4	0·56	34·0	4·0
Central Provinces ..	5·8	2·0	11·7	1·4
Bihar	11·5	0·81	9·3	1·1
Orissa	4·0	0·75	3·0	0·3
Bengal and States ..	5·1	1·1	6·0	0·7
Other areas	9·7	2·0	19·5	2·3
Total for India ..	453·8	1·9	850·3	(100·0)

According to their locations, several varieties of Indian wool are known in commerce such as Joria (Kathiawar), Bikaner (Punjab and Rajputana), Beawar (Rajputana), Fazlika (Punjab), Multan, Kandahar, S. Indian, etc.; and these are sold in bales roughly graded according to their appearance and feel when handled by experienced wool dealers. Feel

is, however, dependent on fibre fineness, their distribution and medullation as has been noted already; and it would be quite possible to have only three or four grades, clearly defined on these physical attributes of the fibres, rather than the confused and uncertain classification prevalent at present.

The principal market centres of wool in India are Peshawar, Lahore, Amritsar, Fazlika, Cawnpore, Bikaner, Jodhpur, Beawar, Karachi, Jamnagar, Bombay, Ahmednagar and Bijapur. Here sales are held twice a year (May and November), and most of the wool for export trade and for local consumption in mills and cottage industries is disposed off. These sales are very often not organised on proper lines, and it is not uncommon to find the middlemen getting most of the profit and the producer the least. It would be realised that gradations according to specified standards, stamping of the goods so classified by a recognised authority and sales on well organised economic lines so that the wool producer gets the maximum of benefits, are the necessary factors to improve the unsatisfactory state of affairs found at present in the wool industry.

Sheep Breeds of India

It is likely to be presumed from what has been said about Indian wool, that this country is incapable of growing fine wool, or that there is no scope in this country for developing good breeds of sheep with fine homogeneous and non-hairy type of wool. The fine-wooled Pashmina goat of the Kashmir frontier and the very limited supply of wool it gives, has already been mentioned. Data obtained during the course of recent work on the fibre characteristics of a number of Indian sheep breeds have amply shown that sheep types producing wool comparable with the Merino quality of the 56'S to 58'S class, do exist in this country. Such breeds of sheep are found in the North Western Frontier Provinces (Hashtanagri and Khagani breeds), in the Kashmir State (Karnah and Gurez breeds), in the Punjab (Hissar dale), in certain parts of Kathiawar, Kutch and Gujarat (Pattanwali) and in the North Deccan (Deccani). However it is only by chance that a few good individuals in each of these breeds survive, for no attempt has ever been made on a large scale to improve the number of good breeds. All the rest of the Indian breeds invariably produce coarse, heterogeneous and highly medullated wool. The few individuals of the better types are always in danger of being contaminated on account of the primitive conditions of indiscriminate breeding, ignorance of the breeders and migration of the flocks to more fertile parts of the country during seasons of pasture scarcity, often involving long journeys. These factors allow sufficient scope for the mixing up of pure breeds with good wool with inferior types. Sheep-breeding farms established by the Government and some States do help to identify, isolate, conserve and breed the good types of sheep; but they could not be expected to undertake large-scale breeding operations, which should be done under present conditions, by the wealthier class of landlords and by floating joint-stock companies. A step in this direction has been recently taken at Patan in Baroda State, where it has been found possible to produce commercially wool of good quality from the Pattanwali breed of Northern Gujarat. More efforts of this type are needed to develop and establish the good sheep breeds of the country, and make Indian wool comparable with class wool from other parts of the world.

The principal breeds of Indian sheep which have been recognised are listed in the table below, together with information on the wool fibre characteristics of some of the best individuals among them.

Sheep Breeds of India

Breed	Region	Fibre length (mm.)	Fineness (microns)	Homogeniety (C. V. in diameter)	Hairy portion (medullation %)
Karnah	Kashmir	87	26	22	0
Gurez	Kashmir	63	22	25	0
Hissardale	Punjab	73	24	19	0
Pattanwadi	Gujarat	98	30	27	0
Khagani	Hazara Dist.	62	33	34	0
Hashtanagri	N.W.F.P.	100	25	39	2
Deccani	Deccan	83	36	32	3
Lohi	Punjab	114	39	27	4
Masuda	Ajmer	33	32	31	8
Bikaner	Rajaputana	149	38	24	3
Damani	N.W.F.P.	38	35	34	18
Bibrik	Baluchistan	103	39	31	20
Bellary	Madras	103	52	36	60
Jalauni	Jalauni Dist. U.P.	66	69	43	58
Khasi	Assam	78	66	58	61

Comparing this table with the last one for commercial wools it is apparent that some of the sheep breeds at the top of the table are capable of giving fine wool of the type needed for the worsted and the clothing industry. However, although there may be a large number of animals in some or any of these breeds, those actually showing good fibre characteristics mentioned are very few. They are generally restricted to small regions or are confined to some experimental farms only, and need a hundred to thousandfold multiplication if the wool produced by them is going to be any industrial value. Thus the Hissardale breed which has been evolved by crossing the Merino and the Bikaner sheep, and which may, therefore, be called Indian Merino, has proved itself quite successful. However, its number is so limited that a large demand which exists from sheep-breeders for a supply of these animals in different parts of the country is not easily met with. The case with the good individuals from the best breeds of Kashmir is also very similar.

Improvements in Coarser Types of Wool

The experimental farms established by the Government ascertain the best conditions under which the good sheep breeds of the districts around may thrive, and undertake a programme of work, according to which inbreeding (in selected flocks) and cross-breeding (with recognised indigenous and foreign breeds) experiments are carried out with the idea of improving wool quality of known breeds and establishing new breeds with desirable fibre characteristics. The process is long, and several years may be required to increase the stock of good breeds sufficiently and to fix new types. Other genetical factors such as the best breeding season of the year and the number of

lambings in a year, have also to be considered. Whatever information is thus obtained on the good breeding of sheep is generally passed on to sheep-breeders in villages and towns for any use they could make of it.

Laboratory Analysis and Assessment of Wool

In any case, for judging the quality of wool, whether in testing the suitability of animals for particular types of experiments or in gauging the success of the experiments already undertaken or in distinguishing between the good and defective types of wools or even for trade requirements, laboratory tests for wool fibres are always necessary. Very little has been done in this respect in this country, but elsewhere definite standards and methods for the assessment of various grades of wool exist, and are recognised by the Government of the country. Accordingly, all wool for trade has to conform to standard specifications.

The most important physical characteristics of wool which determine its quality, as has already been mentioned are the length and the diameter of the fibres, considered together with the amount of individual variations in them. The latter are determined as coefficients of variations from a statistical analysis of individual fibre measurements thus giving a complete idea of the homogeneity or heterogeneity of a sample with respect to the particular characteristic measured. In some cases analysis of variance may have also to be carried out to find whether there is any correlation between the two variables of the fibres such as the length and the diameter. The variance test is also useful in ascertaining the amount of variations to be expected in the fibre characteristics of the individuals in a given breed of sheep. These methods are very helpful in arriving at suitable specifications for wool standards for different breeds of sheep and also for trade purposes in case of commercial wools.

The length is measured to the nearest millimeter by stretching the fibre on a black velvet board against a steel rule placed alongside. In a few cases where the samples have crimps, the unstretched lengths of the whole staple is measured, and the number or crimps per centimeter length calculated from the observed number of total crimps along the staple. About 500 measurements are thus carried out on one specimen, the readings being directly plotted on a sectional paper, so that at the end of an examination, the frequency distribution diagram is obtained. Mean length, standard deviation from the mean and coefficient of variation are calculated from the figures obtained.

For the fineness measurements, a bundle of about 500 fibres is cut up in very small lengths of about 0·3-0·5 mm. in a special type of microtome and a suspension of these is made up in thickened cedar wood oil. A drop of this suspension is placed on a microscopic slide and covered with a cover slip. With a microprojection apparatus the images of the fibres on the prepared slide are projected on a screen, and the width of each is measured with a transparent scale to the nearest half millimeter at least at three points along the length. The mean of these values gives the average width of a single fibre in the field of view. Several fields have to be examined in order to make up the required number of measurements. As the magnification is always maintained at 500 diameters, 1·0 cm. width of the projected fibre corresponds to a fibre diameter of 20 microns ($20\mu = 20 \times 10^{-3}$ mm.). The diameter readings which are correct to the nearest micron are plotted, as for length measurements, on a sectional paper so as to obtain a frequency distribution curve (Figs. 1, 2 and 3). From the measurements thus carried out, the mean, standard deviation and coefficient of variation are calculated.

Medullation, as has been observed before, is a property connected with coarse wool fibres and hairs of many animals. A medullated fibre may be generally distinguished from a wool fibre by its dead white appearance and non-resilient nature. A non-medullated wool fibre on the other hand is semi-transparent or transluscent and possesses a good amount of elasticity. Under the microscope wool fibres appear covered with scales, while hairy or medullated fibres when freshly mounted in a non-alcoholic medium show long dark longitudinal marks in the central portion which may occur at intervals or run for the whole length of the fibre (Fig. 5).

It has been observed before that an undesirable feature of Indian wool is its high degree of medullation. One of the tasks of the Indian breeder, therefore, consists of producing wool free from medullation. A determination of the degree of medullation in a wool sample is thus important from the sheep-breeder's as well as from the commercial point of view. When the image of the wool fibres is projected on the screen for the measurements of diameter, the medullated portion in each of them is also recorded, and the percentage amount of medullation in the number of fibres measured, is calculated from the collective data obtained for any one sample.

Based fundamentally on these fibre characteristics, namely, (*i*) fineness, (*ii*) fineness homogeneity (C.V. in diameter) and medullation, it is possible to arrange various types of sheep breeds according to the quality of wool produced by them. The table on Indian Sheep Breeds has been thus prepared from the results which are known so far.

Wool Standards

From what has been said here about the Indian Wool it would be realised that the present need in this field is to know exactly the types of wool grown in this country. This has to be done for the large quantities of wool in the trade, as well as for the smaller quantities obtainable from the known pure breeds of sheep in the country. When the fibre qualities of each of these types have been established by laboratory tests, standard specifications in terms of physically measurable qualities such as length, fineness, homogeneity, hairiness may be laid down to which various grades of wool would conform. Such standards would be helpful to traders in wool as they can always rely on the specifications under which various types of wool is handled by them. Sheep breeders, on the other hand, would also gain much by the standard specifications as they would be able to judge any improvement in the qualities of wool produced by the specific sheep breeds against a system of standards.

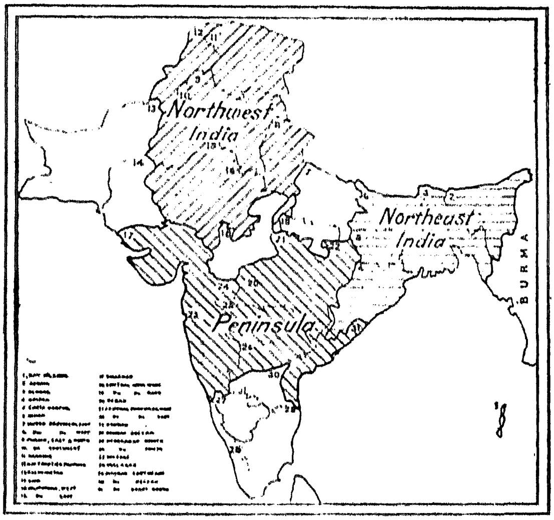
The Indian Council of Agricultural Research through its Wool Committee is devoting its attention to the question of wool standards as well as to other neglected aspects connected with the Indian woollen industry, notably the methods of improving the production, grading and marketing of Indian wool.

SOLAR RADIATION AND THE INDIAN MONSOON*

K. S. RAMAMURTI
(*Poona*)

INTRODUCTION

THE S.W. monsoon or summer monsoon is a major event in the agricultural life of India, which has been widely studied. Malurkar[1] has described the day-to-day forecasting of the monsoon over India from its earlier activity in the Indian Ocean. The local distribution of monsoon rainfall[2] and a forecast of the seasonal rain in various homogeneous divisions of India[3] have been studied by Walker. He divided India into three homogeneous rainfall divisions, *viz.*, N.E. India comprising Assam, Bengal, Bihar and Orissa ; Peninsula comprising Gujarat, C.P., Konkan, Bombay, Deccan, Hyderabad and north Madras Coast ; and N.W. India consisting of the west U.P., Punjab, East and North, Kashmir, N.W.F.P., and Rajputana to which S.W. Punjab has been added on account of its geographical position ; but while weighting the mean rainfall with the area of each sub-division to obtain the mean for the whole of N.W. India, only half the weightage is given to S.W. Punjab. The above divisions are referred to in this paper (see Fig. below).



The chief characteristic of the pressure distributiion over India during the monsoon† is the trough of low which extends from the S.E. Punjab to the head of the Bay and the concomitant high pressure belt in the Indian Ocean. Hence a study of any feature of the monsoon should be based on this background. The low over Upper Burma is another of the summer low pressure cells.

The monsoon follows closely the movements of the sun both in its advent to the north of the equator and in its retreat thereafter.

The changes occurring in the sun such as sunspots, faculæ and flocculi have close relation to changes in the solar radiation outside the atmosphere, particularly to changes in the ultra-violet and blue end of the solar spectrum.[4] Walker found a correlation coefficient of +0·59 with a probable error of about a tenth of this value between 42 monthly mean values of sunspot numbers and solar constant.[5] He also found a correlation of + 0·64 between June—August sunspots and synchronous solar constant.[6]

SOME PREVIOUS WORK IN THE FIELD

Walker recorded the effect of sunspots on the annual rainfall of representative stations all over the world.[5,7] He finds the correlation of sunspots with the total annual rainfall over the plains of India as given by all the stations in existence from 1865 to 1912 to be + 0·26. Satakopan's[8] studies in the Peninsula and N.W. India led him to conclude that "the apparent positive association observed between sunspot numbers and rainfall in India by Walker and others has not been maintained during the recent spot cycles."

Clayton[4] remarks that the centres of high pressure (centres of action) are pushed to higher latitudes with increasing solar activity. They also recede farther from the nearby land areas.

SOURCES OF DATA

The daily values of the solar constant, solar energy in calories per square centimetre per minute outside the terrestrial atmosphere determined at Montezuma, Table Mountain, Mount St. Katherine and Harqua Hala are published in the *Annals of the Astrophysical Observatory of the Smithsonian Institution.* The ten-day and monthly means (preferred and improved preferred values) and their standard deviation from August 1920 to September 1939 are published in Vol. 6 of the *Annals.* The data are given in Table I.

The June to September rainfall departures[2] from 1875 to 1921 for the Peninsula and N.W. India, and the monthly departures[9] from 1875 to 1924 for May to October for the Peninsula and N.E. India and for all the months for N.W. India are published in the *Memoirs of India Meteorological Department.* For subsequent years rainfall data for monsoon season as a whole are taken from the "Statement of Actual Rainfall in the Monsoon Season, June to September", issued every year.

CORRELATION COEFFICIENTS

The correlation between June to September rainfall of these divisions and the mean solar constant in each of the preceding 12 months, as well as June and June to September of the same year are shown in Table II. These correlation coefficients are based on data for 19 years except for the months of August and September which are based on 20 years' data. The values of the correlation coefficient for different levels of significance and 17 degrees of freedom are taken from Fisher.[10]

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† By 'Monsoon' is meant the S. W. monsoon in this paper.

TABLE I

Correlation of Solar Constant with Rainfall in Various Divisions of India

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1920								1·930	1·947	1·945	1·950	1·953
1921	1·957	1·955	1·949	1·947	1·950	1·939	1·950	1·943	1·950	1·955	1·957	1·952
1922	1·947	1·946	1·936	1·920	1·930	1·918	1·914	1·921	1·917	1·925	1·926	1·921
1923	1·942	1·929	1·932	1·931	1·936	1·929	1·937	1·941	1·948	1·945	1·942	1·941
1924	1·941	1·943	1·945	1·941	1·949	1·949	1·951	1·948	1·948	1·951	1·951	1·953
1925	1·949	1·955	1·949	1·948	1·947	1·948	1·949	1·948	1·949	1·945	1·946	1·948
1926* ..	1·946	1·941	1·942	1·939	1·941	1·943	1·942	1·944	1·945	1·939	1·936	1·939
1927	1·939	1·945	1·946	1·945	1·942	1·946	1·944	1·944	1·948	1·942	1·947	1·943
1928	1·940	1·942	1·943	1·942	1·942	1·946	1·943	1·943	1·942	1·944	1·947	1·947
1929	1·947	1·942	1·945	1·945	1·944	1·942	1·940	1·940	1·940	1·939	1·942	·947
1930	1·943	1·944	1·943	1·943	1·948	1·948	1·947	1·947	1·947	1·946	1·948	1·951
1931	1·950	1·949	1·946	1·944	1·948	1·947	1·943	1·948	1·948	1·948	1·948	1·950
1932	1·947	1·945	1·942	1·943	1·941	1·946	·945	1·944	1·946	1·944	1·944	1·947
1933	1·948	1·948	1·944	1·942	1·940	1·943	1·946	1·946	1·948	1·950	1·950	1·951
1934	1·950	1·946	1·947	1·946	1·946	1·949	1·949	1·948	1·948	1·952	1·950	1·950
1935	1·947	1·945	1·948	1·948	1·947	1·947	1·946	1·949	1·947	1·947	1·950	1·951
1936	1·949	1·949	1·948	1·949	1·947	1·949	1·948	1·945	1·946	1·949	1·951	1·949
1937	1·947	1·948	1·945	1·943	1·944	1·946	1·944	1·947	1·947	1·947	1·948	1·952
1938	1·950	1·949	1·950	1·945	1·944	1·945	1·945	1·945	1·947	1·949	1·951	1·951
1939	1·949	1·948	1·946	1·944	1·946	1·944	·945	1·943	1·947			
Mean	1·947	1·946	1·945	1·943	1·944	1·943	1·944	1·943	1·945	1·945	1·947	1·947
S.D.	·004	·005	·004	·005	·005	·007	·008	·007	·007	·006	·007	·007

* Improved preferred means are given from 1926 onwards.

TABLE II

A. Correlation Coefficients

Solar Constant / Division	Preceding year												Same year	
	June	July	Aug	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	June to Sept.
North-east India	+·17	+·45	+·20	+·47	+·53	+·59	+·49	+·36	+·38	+·11	·09	−·14	−·33	−·42
Peninsula ..	+·34	+·21	+·19	+·20	+·11	+·12	+·28	+·40	+·20	+·21	+·14	+·07	+·22	+·28
North-west India	−·21	−·02	−·05	+·02	−·02	−·13	−·07	+·08	−·01	−·17	−·21	·17	−·16	−·08

B. Values of the Correlation Coefficient for Different Levels of Significance

P ..	·10	·05	·02	·01
C.C. ..	·3887	·4555	·5285	·5751

INFERENCE

Monsoon rain in N.E. India seems to have significant positive correlation with the solar constant of each of the months from September to December of the previous year. The rest of the coefficients do not show any significant relationship at five per cent. level of significance. The consistency of the correlation coefficients and their gradual variation month by month makes it probable that the mode of solar variation during the preceding year influences the subsequent monsoon over India. But the limited nature of the data makes these conclusions only tentative. To study the influence of the mode of solar variation on the monsoon rainfall, a polynomial with a set of constants (α, β, γ, δ, etc.) may be fitted to the solar radiation data of the year prior to the monsoon. These constants will then represent the variation of the solar energy in that year. They can be used as independent varieties and correlated with the subsequent monsoon rainfall. This technique would bring out the relationship between the trend in the solar energy and the monsoon rains.

Theoretical Consideration of the Influence of the Shift of Centres of Action on Divergence in the Equatorial Region

That atmospheric circulation increases with the increase of solar activity is indicated by the decrease of pressure in the lower and increase in the higher latitudes.[4b] Simpson[11] discusses the change in the cloud amount with increased solar radiation. Actual data regarding the exact proportions of the increase in solar energy utilised for strengthening atmospheric circulation and lost by reflection into space by the consequent increase in cloudiness are not available. The fact that an increased atmospheric circulation is necessary for an increase in the cloud amount perhaps permits the assumption that for any given condition of circulation and cloud amount a small variation in atmospheric circulation would be proportional to the corresponding variation in solar radiation. The probable proportional variation in solar radiation is small—about 0·25 per cent.

Let A represent the total divergence—total amount of air transported—from the regions of excess insolation to the regions of deficit insolation,

s—the mean effect of insolation on divergence over unit area in excess insolation region,

S—insolation, (represented in terms of the solar constant, sunspots, etc.)

l—the difference in latitude between the mean positions of the centres of action and the latitude at which sun is overhead.

Then considering an area of unit breadth between the centres of action in the two hemispheres,

$$A \propto 2l \cdot s = Kls \text{ (say)} \qquad (1)$$

We may assume that during any given period (*loc. cit.*)

$$\frac{dA}{dS} \text{ is constant.}$$

and,

$$\frac{ls}{dS} = \text{a constant* (first order approximation)} \qquad (2)$$

$$\therefore \frac{dA}{ds} = \frac{dA}{dS} \cdot \frac{dS}{ds} = \text{Constant, } \lambda \text{ say} \qquad (3)$$

Now differentiating (1) with respect to *s*,

$$\frac{dA}{ds} = Kl + Ks\frac{dl}{ds}$$

This reduces to $\frac{ds}{dl} = -\frac{Ks}{Kl - \lambda}$ using relation (3)

$$= -\frac{Ks}{\frac{A}{s} - \lambda} \qquad \text{by (1)}$$

$$= -\frac{Ks^2}{A - \lambda s}$$

It is evident that

$$\frac{\lambda s}{A} < 1$$

$\therefore$ Right side reduces to

$$-\frac{Ks^2}{A}\left(1 - \frac{\lambda s}{A}\right)^{-1}$$

i.e. $$-\frac{K}{A}s^2\left(1 + \frac{\lambda s}{A} + \frac{\lambda^2 s^2}{A^2} + \dots\right)$$

which reduces to

$$\frac{ds}{dl} = -\mu_2 S^2 - \mu_3 S^3 - \mu_4 S^4 \dots$$

—by (2) and assuming initial values to make the constant of integration vanish.

That is, the change in the divergence over unit area in the region of excess insolation as a result of the latitude shift in the position of the centres of action is to reduce the divergence by a quantity which is proportional to $S^2(1 - \gamma s)^{-1}$.

Therefore the combined effect of the insolation and the shift of the centres of high pressure can be represented by the equation

$$s = a_0 + a_1 S + a_2 S^2 + a_3 S^3 + \dots$$

(upto relevant terms), where a_2, a_3, etc., are necessarily negative.

Concluding Remarks

Solar variations from September to December have highly significant positive relationship with the subsequent monsoon rainfall in N.E. India. The Correlation Coefficients of October and November mean solar constant with the monsoon rainfall in N.E. India are significant at 2 per cent. and 1 per cent. levels respectively. This part of India is under the direct sweep of the monsoon winds, and hence rainfall there may be taken to be representative of the activity of the monsoon. The above result suggests definite relationship between the solar variations when the sun is south of the equator (the period of the southern monsoon) and the subsequent monsoon current over India. The mode of variation of the solar radiation in the different months of the preceding year seems to have influence on the monsoon. It is also suggested that a curve of higher order may be fitted with better results. Further studies are in progress.

In conclusion, mention may be made of the limitation of even the curvilinear regression. With the shift of the centres of action both in latitude and in longitude the monsoon current also gets shifted, which effect does not come under the purview of the curvilinear regression. Other accidental events, like severe volcanic eruption throwing a lot of dust particles into the stratosphere, have an influence on the incidence of rainfall by increasing the interzonal temperature gradient. The effects of these and similar causes are evidently outside the scope of the regression equation.

I am indebted to Mr. S. L. Malurkar for suggesting the problem and for going through the manuscript.

* This is the assumption on which linear correlations are based.

1. S. L. Malurkar, *Forecasting Weather in and near India*, 1945 (for limited circulation). 2. *Memoirs of the Indian Meteorological Department* **23**, Part II, 1922. 3. *Ibid.*, **24**, Part X, 1924. 4. (*a*) H. H. Clayton, Solar relations to Weather, 1943, *Clayton Weather Service*, 1410, Washington Street, Canton, Massachussets, U.S.A. (*b*) *Ibid.*, Table I, p. 14. 5. *Memoirs of the Indian Meteorological Department*, **21**, Part X, 1915. 6. Sir Napier Shaw *Mannual of Meteorology*, 1936, Cambridge University Press, **2**, 336. 7. *Memoirs of the Indian Meteorological Department*, 1923, **24**, Part IV. 8. Satakopan V., Sunspots and Monsoon Rainfall in India, *Curr. Sci.*, 1946 **15**, 151. 9. *Memoirs of the Indian Meteorological Department*, **1928**, **25**, Part II. 10. Fisher, *Statistical Methods For Research Workers*, **19** Table V A. 11. *Memoirs of the Royal Meteorological Society*, **3**, No. 21, 1928–30.

LETTERS TO THE EDITOR

ON THE SIGNIFICANCE OF THE ADDITIONAL INFORMATION OBTAINED BY THE INCLUSION OF SOME EXTRA VARIABLES IN THE DISCRIMINATION OF POPULATIONS

THE object of this note is to propose tests of significance for the additional information obtained by supplementing p basic characters with q other characters in the general problem of discrimination of groups. Such problems are of importance in multivariate analysis where the informations supplied by several variates are not independent. For instance in using Fisher's discriminant function one may ask whether the discriminant function based on $p+q$ characters is significantly better than that based on p characters.

(i) Case of k *populations with known co-variable matrix*

Let (α_{ij}) and (β_{ij}) be the covariance matrices for p *and* $(p+q)$ characters with their reciprocals as (α^{ij}) and (β^{ij}). The sample sizes for the k populations are taken as $n_1, n_2, \ldots n_k$ and the sample mean of the i-th character in the j-th population is represented by $\bar{x}_{ij}$. Defining $x_{i.} = \Sigma n_j \bar{x}_{ij}/\Sigma n_j$ we may calculate the generalised variance between populations V_r based on r characters.

	Formula	*d.f.*
	$V_p = \sum_{i,j=1}^{p} \alpha^{ij} \Sigma n_r (\bar{x}_{ir} - \bar{x}_{i.})(\bar{x}_{jr} - \bar{x}_{j.})$	$p(k-1)$
	$V_{p+q} = \sum_{i,j=1}^{p+q} \beta^{ij} \Sigma n_r (\bar{x}_{ir} - \bar{x}_{i.})(\bar{x}_{jr} - \bar{x}_{j.})$	$(p+q)(k-1)$
	$V_{p+q} - V_p$ (difference)	$q(k-1)$

To test for difference in mean value of the p characters for the k *populations* we can use V_p as χ^2 with $p(k-1)$ degrees of freedom. To test for additional differences indicated by the q other characters we can use $V_{p+q} - V_p$ as χ^2 with $q(k-1)$ degrees of freedom. This test can be used as an approximation when the covariance matrix is not known but estimated on a large number of degrees of freedom from the pooled sum of squares and products.

(ii) Two populations when the covariance matrix is unknown

The covariance matrices estimated by dividing the pooled sum of squares and products by the degrees of freedom $(n_1 + n_2 - 2)$ are represented by (a_{ij}) and (b_{ij}) and their reciprocals by (a^{ij}) and (b^{ij}). If $d_i = \bar{x}_{i1} - \bar{x}_{i2}$, then Mahalonobis' generalised distance based on p characters is

$$D_p^2 = \sum_{i,j=1}^{p} a^{ij} d_i d_j$$

and the one based on $(p+q)$ characters is

$$D_{p+q}^2 = \sum_{i,j=1}^{p+q} b^{ij} d_i d_j$$

To test for additional information we need

compare these distances. One such comparison is given by the ratio

$$U = \frac{1+\frac{n_1 n_2}{(n_1+n_2)(n_1+n_2-2)} D_{p+q}^2}{1+\frac{n_1 n_2}{(n_1+n_2)(n_1+n_2-2)} D_p^2}$$

To test the significance of U, we can use $(U-1)(n_1+n_2-p-q-1)/q$ as variance ratio with q and $(n_1+n_2-p-q-1)$ degrees of freedom. This supplies the test for judging whether the discriminant function based on $p+q$ characters is significantly better than the one based on p characters.

(iii) The case of more than two populations and one additional variable

Let there be k populations, p basic characters and one additional character. To find the additional information due to this we find the differences in populations as indicated by this character when those due to the first p characters are removed. Let $b_1, b_2 \ldots b_p$ be the regression coefficients of x_{p+1} on $x_1, \ldots x_p$ in which case they are calculated from the equations.

$$c_{p+1\, i} = b_1\, c_{1i} + \ldots + b_p\, c_{pi},\ i=1, 2, \ldots p$$

where c_{ij} is the pooled sum of products for the i-th and j-th characters. If $\bar{y}_m$ denotes the difference between the observed mean value of the $(p+1)$-th character and the mean value as predicted from the first p characters for the m-th population, then

$$\bar{y}_m = \bar{x}_{p+1\, m} - b_1\, \bar{x}_{1\, m} - \ldots - b_p\, \bar{x}_{pm}$$

and $\quad \text{cov.}\,(y_m\, y_r) = \lambda_{mr} = \sum_i \sum_j \bar{x}_{im}\, \bar{x}_{jr}\, c^{ij}$

where c^{ij} is an element of the matrix reciprocal to (c_{ij}), $i, j+1, 2, \ldots p$. If (λ^{mr}) is reciprocal to (λ_{mr}) then the variance v^2 between the populations due to the $(p+1)$-th character when the part due to the first p is removed is $\frac{1}{(k-1)} \Sigma\Sigma\, \lambda^{mr}\,(y_m - \bar{y})(y_r - \bar{y})$ where $\bar{y}$ is given by $\Sigma\Sigma\, \lambda^{mk}\,(y_m + y_r - \bar{y}) = 0$. The estimate of internal variance is s^2 where

$$(n_1+n_2-p-2)\, s^2 = c_{p+1\, p+1} - \sum_{i=1}^{p} b_i\, c_{p+1\, i}$$

To test the above hypothesis we can use v^2/s^2 as a variance ratio with $(k-1)$ and (n_1+n_2-p-2) degrees of freedom.

(iv) The general theory of residual canonical roots

We can extend the above test to the case of q extra variables. The regression coefficients of the $(p+t)$-th variate on the first p are obtained from the equations

$$c_{p+t\, i} = b_{1t}\, c_{1i} + \ldots - b_{pt}\, c_{pi}\ i=1, 2, \ldots p.$$

The residuals for the m-th population are given by

$$\bar{y}_{tm} = \bar{x}_{p+t,m} - \Sigma_j\, b_{jt}\, \bar{x}_{jm}\ t=1, 2, \ldots, q.$$

The covariance matrix between the populations is given by (t_{ij}) where

$$(k-1)\, t_{ij} = \Sigma\Sigma\, \lambda^{rs}\,(\bar{y}_{ir} - \bar{y}_{i.})(\bar{y}_{js} - \bar{y}_{j.})$$

the λ's and $\bar{y}_{i0}$'s being same as those defined in section (iii). The intra-covariance matrix is given by (s_{ij}) where

$$(\Sigma n_i - k - p)\, s_{ij} = c_{p+i\, p+j} - \sum_{r=1}^{p} b_{ri}\, c_{p+j\, r}$$

To test whether the residuals differentiate between the populations we need find the significance of the latent roots of the determinantal equation

$$| t_{ij} - R s_{ij} | = 0$$

There are $q-1$ or $k-1$ (whichever is smaller) nonzero values of R satisfying the above equation. When once the nature of tests with roots of determinantal equations are set forth the above problem is simultaneously solved.

An elaborate treatment of this test together with some practical applications will be given elsewhere.

King's College,
Cambridge, C. RADHAKRISHNA RAO.
March 20, 1947.

THE KINEMATICS OF ROTATING FRAMES OF REFERENCE

I ASK leave to comment on Mr. Kamala Prasad Singh's letter[1] "A fundamental result for rotating rectangular Cartesian frames". Before considering his result and its interpretation, it is necessary to state briefly the standard kinematical results involved. The methods and notation of the vector calculus[2] are employed here for the sake of simplicity and generality.

Let F_1 and F_2 be two frames of reference, $O\,x_1y_1z_1$ and $Ox_2y_2z_2$ having the common origin O but changing their orientations relative to each other with respect to time (t) Θ_2 being the spin of F_1 relative to F_2 at any instant. Let $\begin{Bmatrix} D_1 \\ D_2 \end{Bmatrix}$ represent the operation of differentiation with respect to t relative to the base represented by $\begin{Bmatrix} F_1 \\ F_2 \end{Bmatrix}$. Let P be a point moving relative to F_1 or F_2 or both, the vector $\overrightarrow{OP}$ being denoted by r and let $\begin{Bmatrix} V_1 \\ V_2 \end{Bmatrix}$ and $\begin{Bmatrix} a_1 \\ a_2 \end{Bmatrix}$ be the velocity and acceleration respectively of P relative to $\begin{Bmatrix} F_1 \\ F_2 \end{Bmatrix}$. Then, If **A** is any vector, the relation between D_1 **A** and D_2 **A** is given by the Coriolis theorem, viz.,

$$D_2\, \mathbf{A} = D_1\, \mathbf{A} + {}_1\Theta_2 \times \mathbf{A} \tag{1}$$

Since $\quad {}_1\Theta_2 \times {}_1\Theta_2 = 0$;

$$D_2\,({}_1\Theta_2) = D_1\,({}_1\Theta_2) = {}_1\dot{\Theta}_2 \tag{2}$$

the overhead dot being used for simplicity and also for indicating the equivalence of D_1 and D_2 in relation to ${}_1\Theta_2$.

Taking into account (1), (2) and the definitions $\mathbf{V}_1 = D_1\, r$, $\mathbf{V}_2 = D_2\, r$, $\mathbf{a}_1 = D_1\,(D_1\, r)$, $\mathbf{a}_2 = D_2\,(D_2\, r)$, we have the relations,

$$\mathbf{V}_2 = \mathbf{V}_1 + {}_1\Theta_2 \times r \tag{3}$$

and

$$\mathbf{a}_2 = \mathbf{a}_1 + {}_1\Theta_2 \times (\mathbf{V}_1 + \mathbf{V}_2) + {}_1\dot{\Theta}_2 \times r \tag{4}$$

or

$$\mathbf{a}_2 = \mathbf{a}_1 + 2\,({}_1\Theta_2 \times \mathbf{V}_1) + {}_1\Theta_2 \times ({}_1\Theta_2 \times r) + {}_1\dot{\Theta}_2 \times r \tag{5}$$

If, and only if ${}_1\dot{\Theta}_2 = 0$, i.e., ${}_1\Theta_2$ is constant, (4) and (5) become

$$\mathbf{a}_2 = \mathbf{a}_1 + {}_1\Theta_2 \times (\mathbf{V}_1 + \mathbf{V}_2) \tag{4'}$$

or

$$\mathbf{a}_2 = \mathbf{a}_1 + 2\,({}_1\Theta_2 \times \mathbf{V}_1) + {}_1\Theta_2 \times ({}_1\Theta_2 \times r) \tag{5'}$$

In deriving the above results, it *has* not been assumed that the pairs of axes $\{Ox_1, Ox_2\}$, $\{Oy_1, Oy_2\}$, $\{Oz_1, Oz_2\}$ coincide at any instant, as Mr. Singh has done,

(4′) implies that, When Θ_{12} is constant, the vector $a_2 - a_1$ is perpendicular to both ${}_1\Theta_2$ and $V_1 + V_2$; Mr. Singh's letter might make a reader think that $a_2 - a_1$ is perpendicular to $V_1 + V_2$ only.

As a_1 and a_2 are the accelerations of P relative to the coinitial frames F_1 and F_2 respectively, the vector difference $a_2 - a_1$ has no kinematical significance for either P or F_1 or F_2. The vector representing the difference of the accelerations of a moving point relative to two frames is the acceleration of the origin of one frame relative to the origin of the other only when the orientations of the frames remain relatively unchanged with respect to t and when the origins move relative to each other. If the origins as well as the orientations of two frames remain fixed relative to each other with respect to t, the $\left\{\begin{matrix}\text{velocity}\\ \text{acceleration}\end{matrix}\right\}$ of a point relative to any one frame would be equal to the $\left\{\begin{matrix}\text{velocity}\\ \text{acceleration}\end{matrix}\right\}$ of the point relative to the other frame, and the vector difference between the $\left\{\begin{matrix}\text{velocities}\\ \text{accelerations}\end{matrix}\right\}$ of the point relative to the two frames would just vanish.

Hence, it is to be feared that Mr. Singh's description of $a_2 - a_1$ as "relative acceleration" is unjustified and kinematically unsound, and that his interesting result that $a_2 - a_1$ is perpendicular to $V_1 + V_2$ is of algebraic interest only.

C. E. Pendse.

Poona,
March 30, 1947.

1. Singh, *Curr. Sci.*, 1947, **16**, 45. 2. The cross, '×', denotes the Vector Product.

ANALYSIS OF GRAPHITE

Although graphite is a mineral of considerable industrial importance, literature on its chemical analysis is meagre. The most widely used methods for determining carbon contents of graphite samples are the following:—

(*i*) Dry combustion method in which the weighed sample is mixed with an excess of copper oxide, heated in oxygen and the carbon dioxide evolved adsorbed and weighed;

(*ii*) Wet combustion method in which oxidation is brought about by means of a mixture of chromic and sulphuric or phosphoric acids; and

(*iii*) Berthier's method in which the weighed sample is mixed with an excess of litharge (total weight known) and the loss in weight on ignition noted.

The first method gives accurate results and the second generally gives lower results but both are slow and tedious. The third method is best suited for rapid routine work.

In the course of our investigations on the concentration of South Indian Graphites[1] the need for a rapid method of analysis which leaves the gangue unaffected was keenly felt. For the determination of the fixed carbon in graphite and pencil composition, Mitchell[2] suggested strong ignition in a covered platinum dish over a Bunsen flame until constant weight was reached. Our own experiments, however, showed that while oxidation by ignition in air was more rapid in a platinum than in a silica dish, constant weight was not reached after several hours of continuous ignition. This is not surprising as graphite is practically non-combustible below 650° C.,[3] and at higher temperatures oxidation in air is very slow. Mellor[4] records that Donath and Lang had ignited graphite in a capacious Rose's crucible in an atmosphere of oxygen. Using the principle of Donath and Lang's method, the authors have carried out some analysis on South Indian graphites.

The samples of graphite for analysis were tested for carbonate and sulphide minerals. Those contaminated by carbonate and sulphide minerals were not used for this study on account of the possible sources of error that they might introduce. Complete oxidation of the carbon could be secured in thirty minutes using a platinum crucible covered with a perforated lid through which a current of dry oxygen could be maintained. The mineral matter associated with the graphite is left behind in the crucible as residue. Results of analyses by the ignition and the wet oxidation methods are given in the following table. In all cases the graphite samples were first heated to constant weight at 200–210° C.

Table

Estimation of Carbon in Graphite by the Ignition and Wet Oxidation Methods

Sample of Graphite	Carbon per cent.	
	Ignition method	Wet Oxidation
Godavary ..	46·0	44·3
" ..	44·7	43·1
" ..	35·9	34·6
" ..	34·1	32·4
Koraput ..	34·8	33·1
" ..	33·8	32·7

The ignition method clearly yields in all cases a higher value for carbon than the wet oxidation method. Microscopic examination of the gangue obtained by floating the samples shows that quartz is the main constituent and this is accompanied by a little felspar. The ignition method is simple and saves time, an important factor in flotation experiments.

The authors wish to thank Prof. C. Mahadevan and Dr. K. Neelakantam for their kind interest in this work.

Departments of Geology C. Karunakaran.
and Chemical Technology, M. Narasinga Rao.
Waltair,
June 20, 1947.

1. Karunakaran and Narasinga Rao, *Curr. Sci.*, 1946, **15**, 285. 2. Mitchell, *Recent Advances in Analytical Chemistry*, 1931, **2**, 196. (J. and A. Churchill, London). 3. Clarke, F. W., *The Data of Geochemistry* 1916, 326 (Govt. Printing Office Washington). 4. Mellor, *Treatise on Quantitative Inorganic Analysis*, 1938, 639 (Griffin, London).

USE OF WESTPHAL BALANCE IN SEDIMENTATION ANALYSIS

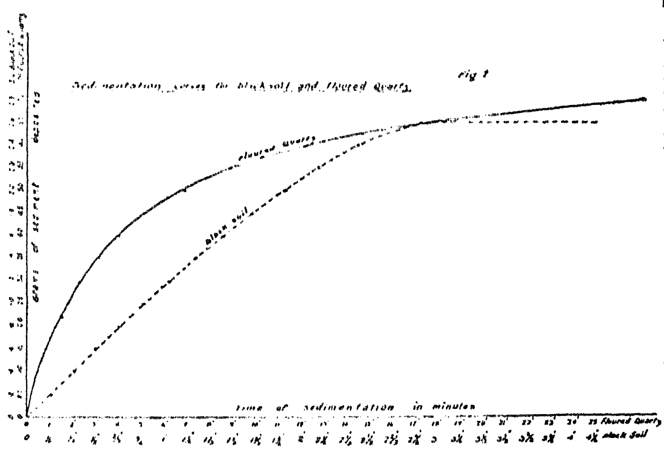
ODEN[1] devised an accurate method of soil classification on the basis of continuous particle size-distribution curves.

The author has now adapted the Westphal Balance for the mechanical analysis of soils on Oden's principle. The weighted sinker of the balance is replaced by a mica pan weighted with a steel wire at the centre. The movement of the beam, and therefore of the pan, is restricted to 2 mm. from the horizontal.

To start with the pan is kept under the pure liquid upto a known depth (20 cm.). The rider is placed immediately above the knife-edge carrying the pan. Then the balance is brought to a horizontal position with the movable weight at the other end. The rider is shifted through one division towards the central knife-edge. The liquid is carefully replaced by the soil suspension up to the same depth of the liquid, and the time taken for the beam to assume the horizontal position noted with a stop-watch. The rider is shifted rapidly through another division in the same direction, and the time taken for the beam to regain the horizontal position is again noted. This operation is repeated till the sedimentation is complete.

The shifting of the rider through equal divisions is equivalent, as in Oden's sedimentation balance, to counter-balancing with a number of weights of equal masses. The mass of sediment deposited on the pan at any given position of the rider when the beam of the balance is horizontal is given by $W = R\frac{N}{M}$ where

W = mass of sediment deposited on the pan,
N = division at which rider is at that instant,
M = number of equal divisions into which the beam, between the two knife-edges, is divided,
R = mass of rider.



The sedimentation or accumulation curves for black soil and quartz flour are thus obtained by plotting the data as illustrated in the following figure. From these the distributive curves can be derived graphically or mathematically.

A detailed paper embodying the technique and results for other samples will be published elsewhere.

In conclusion I express my thanks to Prof. C. Mahadevan for his keen interest in the work.

Department of Geology,
Andhra University,
Waltair, N. SATHAPATHI.
June 21, 1947.

1. Oden, S., *Int. Mitt. Bodenk.*, 1915, 5, 257.

PHOTOCHEMICAL AFTER-EFFECT IN THE DECOMPOSITION OF HYDROGEN PEROXIDE BY POTASSIUM FERROCYANIDE

IT has been reported that the illumination of aqueous potassium ferrocyanide results in the formation of appreciable quantities of the aquo-salt (II), potassium aquopentacyanoferrite, and this brings about rapid decomposition of hydrogen peroxide in the dark as measured by the photochemical after-effect.[1] The photo-formation of the aquo-salt (II) from ferrocyanide is a reversible reaction. It has also been suggested that the aquo-salt (II) is in itself light-sensitive, and is decomposed by light in a short time. It undergoes slow and complicated changes on standing in the dark in the presence of air finally producing ferrocyanide, ferricyanide and ferric hydroxide. The same reactions take place on heating but relatively rapidly.

The validity of these conclusions has been experimentally tested. It has been possible to reproduce the photochemical after-effect in this reaction in the dark by using minute quantities of pure sodium aquopentacyanoferrite (II) with the unilluminated solutions of ferrocyanide. Pure aquo-salt (II) was prepared in the laboratory by the method of Hofmann,[2] and varying quantities of this substance were mixed with the usual amounts of ferrocyanide and hydrogen peroxide in the dark. The rate of decomposition so obtained is of the same order as the photochemical after-effect. It was further discovered that a minimum concentration of ferrocyanide is essential for keeping the unimolecular rate at a constant value. With lower concentrations of the ferrocyanide, the unimolecular velocity constant goes on decreasing from the beginning to the end of the decomposition. The same behaviour is observed when the ferrocyanide is not used, but decomposition of hydrogen peroxide takes place in the presence of the aquo-salt (II) alone. In the following experiments (40° C.), pure aqueous hydrogen peroxide (N/6) was used with 0·0025 gm. of the sodium aquo-salt (II) in 50 c.c. of the reaction mixture in the dark. The velocity constant, K, has been calculated by the usual equation $K = 1/t \log a/a - x$, where t represents time in minutes, a the initial concentration of hydrogen peroxide in terms of c.c.s of potassium permanganate, and x the change in time t.

TABLE I
Without Ferrocyanide

t (*minutes*)	$a-x$	$K \cdot 10^4$
0	16·20	..
20	11·90	67
30	10·00	54
64	8·75	42
90	7·90	35
129	7·15	28

TABLE II
Ferrocyanide = M/1066·7

t (*minutes*)	$a-x$	$K \cdot 10^4$
0	20·10	..
7	16·50	122
21	14·00	75
41	11·70	57
77	9·00	45
132	6·60	36
195	5·20	30
201	4·00	24

TABLE III
Ferrocyanide = M/533·3

t (*minutes*)	$\iota - x$	$K \cdot 10^4$
0	19·60	..
10	15·15	112
17·5	12·75	107
42	8·05	92
62	4·65	96
90·5	2·35	102

TABLE IV
Ferrocyanide = M/320

t (*minutes*)	$a-x$	$K \cdot 10^4$
0	19·10	..
7	14·10	188
17	10·30	158
41	4·40	156
64·5	1·35	179

These results show that the effect of concentration of the aquo-salt (II) is determined by the concentration of ferrocyanide in the reaction mixture. The results of experiments performed by using a constant amount of unilluminated ferrocyanide (M/320) and varying quantities of the sodium aquo-salt (II) in 50 c.c. of the reaction mixture are summarised below ;—

TABLE V

Sodium aquo-Salt (gm $.10^{-4}$)	$K \cdot 10^4$ (Average value)
0·5	5·5
1·0	11·5
5·0	44·5
10	66·8
20	159
25	170
30	215
50	345
100	581

It is clear that the photochemical after-effect can be reproduced in the dark by suitably choosing the concentrations of the ferrocyanide and the aquo-salt (II). A complete similarity in the course of the after-effect by light and by the aquo-salt (II) added in the dark to $K_4Fe(CN)_6$-H_2O_2 mixture becomes obvious. This reaction is highly susceptible to traces of impurities, for in parallel experiments there occur sometimes variations of more than 20 per cent., which cannot be ascribed to errors in manipulation but can only be accounted for by impurities in the air of the laboratory.[3]

It was suggested by the author[4] that the primary oxidation process

$$2\,K_3Fe(CN)_5H_2O + H_2O_2 \rightarrow 2\,K_2Fe(CN)_5H_2O + 2KOH + \text{Energy}$$

is responsible, by virtue of the liberated energy, for the decomposition of a large number of hydrogen peroxide molecules. The aquo-salt (III) so formed is instantly reduced to aquo-salt (II) by the ferrocyanide and the system $Fe(CN)_5H_2O''' \rightleftharpoons Fe(CN)_5H_2O''$ continues to decompose hydrogen peroxide at a constant rate. It follows, therefore, that the aquo-ferrate (III) in the presence of ferrocyanide should be capable of reproducing almost quantitatively the results obtained with aquo-ferrite (II). This point has been fully substantiated by employing suitable concentrations of pure sodium aquo-pentacyanoferrate (III) obtained by Hofmann's method. In 50 c.c. of the reaction mixture, 0·0025 gm. of the violet aquo-salt (III) was used.

TABLE VI
Without Ferrocyanide

t (*minutes*)	$a-x$	$K \cdot 10^5$
0	16·40	..
22	16·20	24
48	12·00	283
74	7·00	500
94	4·65	582

These results show that sodium aquopentacyanoferrate decomposes hydrogen peroxide in presence of ferrocyanide in the same manner as the aquo-ferrite (II). Moreover, the course of the decomposition in presence of relatively smaller amounts of ferrocyanide is similar to

that shown by sodium aquopentacyanoferrite under the same conditions. A little higher value of K in the presence of the aquo-salt (II) (Tables 2-4) as opposed to those obtained in the presence of the aquo-salt (III) (Tables 7-9) may be due to some alkali produced ini-

TABLE VII

Ferrocyanide = M/1066·7

t (*minutes*)	$a-x$	$K \cdot 10^4$
0	15·05	..
11·5	12·00	86
30	9·70	64
57	7·25	56
83	5·40	54
108	4·30	50

TABLE VIII

Ferrocyanide = M/533·3

t (*minutes*)	$a-x$	$K \cdot 10^4$
0	14·50	..
11	11·60	88
27	8·80	80
52	5·60	80

TABLE IX

Ferrocyanide = M/320

t (*minutes*)	$a-x$	$K \cdot 10^4$
0	14·10	..
11	10·10	132
24	7·20	122
42·5	3·65	138

tially in accordance with the reaction

$$2\,K_3Fe\,(CN)_5H_2O + H_2O_2 \rightarrow 2\,K_2Fe(CN)_5H_2O + 2\,KOH + \text{Energy}$$

This extra alkali is not present in the reaction involving the aquo-salt (III) and ferrocyanide. The significance of the results recorded in Table 1 and 6 will be discussed later.

Experiments have also been performed by restoring in the dark in the original concentration the hydrogen peroxide decomposed in the pre-illuminated H_2O_2-$K_4Fe(CN)_6$ mixture after various time intervals from the moment of complete decomposition. It has been observed that such a mixture after complete decomposition retains for several hours the ability to decompose fresh hydrogen peroxide added in the dark in a qualitatively similar fashion as the photochemical after-effect. This behaviour, which may be called the "Secondary After-effect"[5] has been traced to the presence of unchanged potassium aquopentacyanoferrite at the end of the reaction. In the presence of air aqueous solutions of the aquo-salts (II) undergo a slow spontaneous change on standing in the dark at room temperatutre (35° C.) with a concomitant decrease in the reactivity as measured by the rate of hydrogen peroxide decomposition. Since the decomposition in an insolated mixture is complete in less than an hour, the activity can be detected by the addition of fresh hydrogen peroxide, and the catalyst, aquopentacyanoferrite (II), can be identified in the end solutions by characteristic colour reactions with p-nitrosodimethylaniline or nitrosobenzene. These are very sensitive reagents for the aquo-salt (II).

Fuller details will be published elsewhere.

Chemical Laboratory,
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Dehra Dun, B. B. LAL.
March 1, 1947.

1. Lal, B. B., *Curr. Sci.*, 1947, **16**, 118. 2. Hofman, K. A., *Annalen.*, 1900, **312**, 31. 3. Lal, B. B., *J. Indian Chem. Soc.*, 1939, **16**, 7, 323–24. 4. —— *Curr. Sci.*, *Ibid.* 5. MacMahon, P. S., and Lal, B. B., *J. Indian Chem. Soc.*, 1940, **17**, 429.

UNSAPONIFIABLE MATTER IN SHARK LIVER OILS

THE vitamin A content of Shark liver oils has been extensively studied in India. But the limits of variation of other physical and chemical characteristics of the oil are not available. The Indian pharmacopœial List[1] gives the following limits: *Acid value* ≯ 2, *saponification value* ≯ 200, unsaponifiable matter ≯ 2 per cent.; and Iodine value ≮ 90.

Forty-seven samples of genuine shark liver oil from different provinces have been analysed in this laboratory; and the data of 17 representative samples are given in Table I.

TABLE I

Chemical constants of Shark Liver Oils

	Acid value	Per cent. unsaponifiable matter	Blue value[4]
Bengal ..	0·62	2·1	30
	0·61	14·5	50
	0·60	15·0	69
	1·1	3·0	550
	2·0	8·6	40
	0·9	8·9	75
Madras ..	15·8	3·2	50
	1·2	3·9	32
	1·4	4·5	140
	1·0	2·5	34
Bombay ..	0·35	1·0	23
	6·8	1·66	176
Karachi ..	2·6	4·5	330
	0·62	6·7	380
	1·9	3·3	900
	1·4	1·5	17
Orissa ..	7·2	1·84	40

Out of seventeen samples tested, the unsaponifiable matter in 14 samples is consider-

ably higher than 2 per cent., the maximum fixed in the Indian Pharmacopœial List. Most of the values range between 3 and 7. A *lower limit of 3 and an upper limit of* 7 would appear to be more reasonable for Indian oils. The N.N.R.[2] (1944) has also prescribed the limits between 3 and 6.

The unsaponifiable matter taken with the *Saponification value* and *Iodine value*, offer an important criterion for the purity of shark liver oil. The B.P.[3] permits ≮ 1·5 per cent. in cod liver oil and values between 7 and 13 for halibut liver oil. It was also found that no correlation existed between the vitamin A and unsaponifiable matter of shark liver oil.

Central Drugs Laboratory, Government of India, 110, Chittaranjan Avenue, Calcutta 12,
May 30, 1947.

N. K. IYENGAR.
T. HOSSAIN.
B. MUKERJI.

1. Indian Pharmacopoeial List, 1946, Govt. of India Press, Civil Lines, Delhi. 2. New and Non-Official Remedies, 1944, *Amer. Pharm. Assoc., Chicago.* 3. British Pharmacopoeia, 1932, General Medical Council, London. 4. *Ibid.*, p. 596.

EFFECT OF CENTRIFUGAL SPINNING ON THE SYNERESIS OF SODIUM OLEATE GELS IN PINENE

THE kinetics of syneresis of sodium oleate gels in pinene is modified by changes in physical conditions and also by the addition of other substances.[1,2] The author has found that it is also modified considerably when these gels are subjected to centrifugal force.

Gels containing different amounts of sodium oleate in 10 c.c. of pinene, prepared in graduated glass test-tubes as described by Prasad and Hattiangdi,[3] were centrifuged at 30° C. for known intervals of time. The amount of the liquid exuded and the volume of the shrunken gel were noted. The percentage ratios of the liquid exuded to the total volume of the gel are given below.

TABLE I

Effect of centrifugal force (2,000 r.p.m.) on syneresis of sodium oleate gels in pinene

Time (minutes)	Sodium oleate in gm.			
	0·05	0·10	0·15	0·20
0	..	..	..	..
5	55	45	35	26
10	67·5	54	42·5	35
15	72	58	48	38
20	73	62·5	51	40
25	73·5	63 5	52	41
30	73·5	64	52·5	41·5

It is seen from Table I that at a given speed of the centrifuge, the amount of the liquid exuded increases with time and reaches an almost constant value after about half an hour. The facile removal of the syneretic liquid initially indicates that it exists in a free state in the interfibrillary spaces, the remaining liquid which is not exuded being enclosed in a bound state inside the micelles. Further, the amount of the liquid exuded decreases as the soap content of the gel is increased, indicating thereby that the amount of the bound liquid has increased, due evidently to the increased aggregation of the gel micelles.

The relation between the soap content and the bound liquid was found to be linear. Prasad, Hattiangdi and Wagle[4] find that no gels are formed when the soap content is less than 0·020 gm.; hence, the aforesaid straight line has no real points in the concentration range, 0–0·020 gm.

The effect of the speed of the centrifugal spin is brought out in Table II.

TABLE II

Effect of variation of centrifugal speed on syneresis of sodium oleate gels in pinene

(Concentration of sodium oleate 0·10 gm.)

Time (minutes)	Centrifugal spin (r.p.m.)			
	0	750	1250	2000
10	0·95	2	5·5	54
15	1·3	4·5	13·5	58
25	1·9	7·5	20	63·5

It is seen that with an increase in the centrifugal speed, the amount of the liquid exuded increases, at first slowly and then rapidly. Therefore the indications are that large pressures are necessary for the removal of a major portion of the free liquid which is held by forces of attraction inside the gel system. It is probable that when very large pressures are applied some of the bound liquid could also be removed from the intermicellary spaces and exuded as a synereticum.

The author is grateful to Principal Dr. Mata Prasad for his kind interest in this investigation, and to the University of Bombay for the award of a Research Scholarship.

Chemical Laboratories, Royal Institute of Science, Bombay,
June 23, 1947.

G. S. HATTIANGDI.

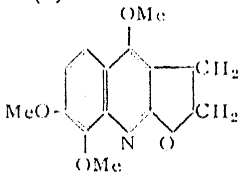
1. Prasad, Hattiangdi and Adarkar, *Proc. Indian Acad. Sci.*, 1945, **22**, 320. 2. Prasad, Hattiangdi and Mathur, *Ibid.*, 1945, **21**, 105. 3. Prasad and Hattiangdi, *Ibid.*, 1945, **21**, 1. 4. Prasad, Hattiangdi and Wagle (Communicated for publication).

ON THE ACTIVE PRINCIPLES ISOLATED FROM THE LEAVES AND THE BARK OF *SKIMMIA LAUREOLA* HOOK.

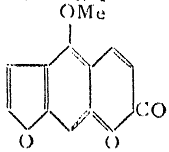
THE leaves of *Skimmia laureola* Hook, the common fodder plant of India, has been examined chemically by various workers,[1-7] and have been found to contain (1) an alkaloid-skimnianine, m.p. 176–177° (1), (2) a furocoumarin—bergapten, m.p. 188–190°, a neutral substance—skimmiol, m.p. 279–281° C., and essential oils. While isolating skimmianine from the leaves of *Skimmia laureola* for collecting an authentic sample of the alkaloid, it has been found by the authors that the leaves contain three more active principles which have not been recorded by previous workers. One of them is isopimpinellin (III), a dimethoxy furo-

coumarin (m.p. 150°; yield, 0·005 per cent.), the second one is umbelliferone (IV) (m.p. 230°; yield, 0·1 pepr cent.), and the third active principle is a neutral compound, $C_{24}H_{20}O_8$ (m.p. 258-260° C.; yield, 0·02 per cent.) which has been hitherto unknown. This neutral compound has been called laureoline.

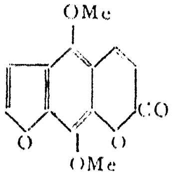
(I) Skimmianine



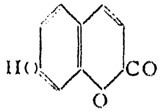
(II) Bergapten



(III) *Iso*pimpinellin



(IV) Umbelliferone



The bark of this species which has not been investigated as yet has also been studied. From the bark all the coumarins, namely, bergapten (II) (m.p. 188°; yield, 0·02 per cent.), *iso*-pimpinellin (III) (m.p. 150°; yield, 0·003 per cent.) and unbelliferone (IV) (m.p. 230°; yield, 0·05 per cent.), and the same alkaloid skimmianine (I) (m.p. 177°; yield, 0·001 per cent.) and laureoline too (m.p. 258-260°; yield, 0·01 per cent.) have been isolated in the pure state. Further work is in progress, the details of which will be published elsewhere.

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June 1947.

1. Roure-Bertrand Fils, *Bull.*, 1920, Oct. 34. 2. Schimmel, *Ber.*, 1926. Apr., 46. 3. Simonsen, *J. Soc. Chem. Ind.*, 1921, **40**, T. 126. 4. Schimmel, I. C., *Constanten*, 1923, 72. 5. Schimmel and Co-Rept., 1932, 5–73. 6. Wienhaus and Rajdhan, *J. Prakt. Chem.*, 1936, **147**, 113. 7. Chopra, Chatterjee, Dey and Ghosh, *Indian J. Med. Research*, 1938, **26**, 481.

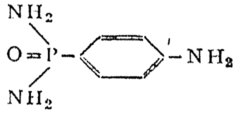
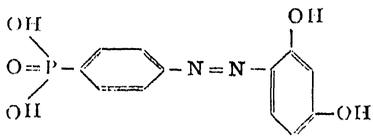
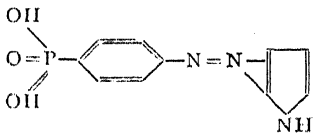
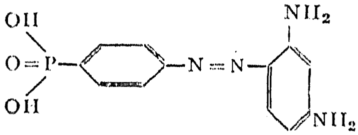
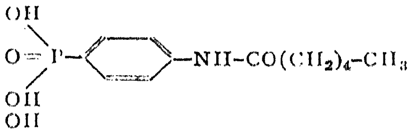
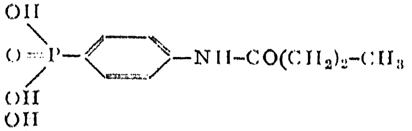
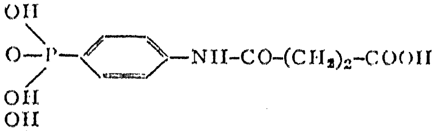
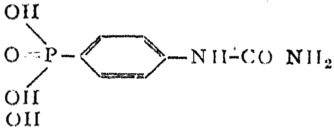
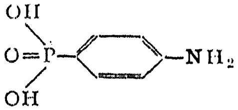
ANTIBACTERIAL ACTIVITY OF p-AMINO-BENZENE-PHOSPHONIC ACID (PHOSPHANILIC ACID) AND ITS DERIVATIVES

A RECENT note of Klotz and Morrison[1] describes the anti-bacterial activity of *p*-amino-benzene-phosphinous acid on *E. coli*. The activity was found to be slightly less than that of sulphanilamide.

Bhide and Limaye[2] prepared a number of derivatives of phosphanilic acid, whose anti-bacterial activity is briefly given in this note.

The method of testing was the Heatley cup method.[3] As the substances used were insoluble in water, their solutions in sodium bicarbonate were used. Laboratory cultures of the following organisms were used: (*i*) *E. coli*, (*ii*) *Staphilococcus aureus*, (*iii*) *Typhi murium* (O), (*iv*) *Corynebacterium xerosis* and (*v*) Boyd II. The results are given in Table I.

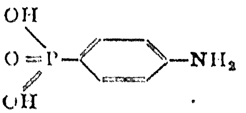
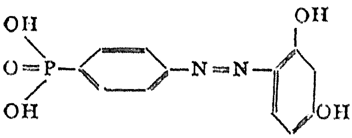
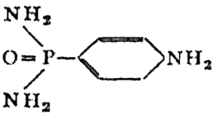
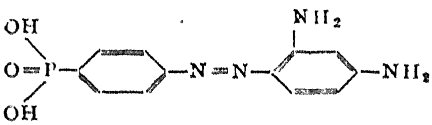
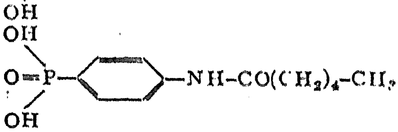
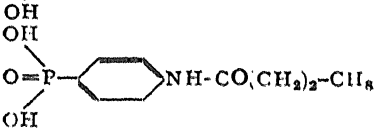
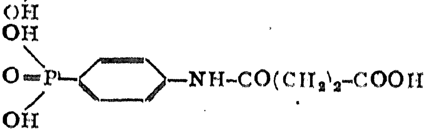
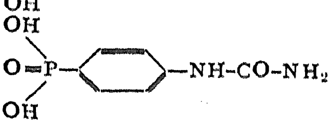
TABLE I
Inhibitory activity of some derivatives of Phosphanilic Acid at 1 per cent. concentration of the compound

Compound	Zone of inhibition in mms.	
	E. coli	*Staphylococcus aureus*
	5	12
	6	6
	2	0·0
	2	0·0
	1	1
	2	0·0
	4	1
	2	0·0
	No clear zone: very little growth for 12	12

Further experiments were carried out with a concentration of 0·1 per cent. Table II gives the results.

TABLE II

Inhibitory activity of some Phosphanilic Acid derivatives at 0·1 per cent. concentration of the compounds

Compound	Zone of inhibition in mms				
	E. coli	*Staphylococcus aureus*	*Typhi murium*	*C. xerosis*	Boyd II
	1·0	10·0	7·0	0·0	10·0
	1·0	1·0	0·0	0·0	10·0
	..	..	7·0	0·0	0·0
	..	..	0·0	0·0	0·0
	..	..	0·0	0·0	0·0
	..	..	0·0	0·0	0·0
	..	..	1·0	0·0	0·0
	..	..	0·0	0·0	0·0

It will be seen from these tables that phosphanilamide and phosphanilic acid are active in varying degrees against *E. coli*, *Staphylococcus aureus*, and *Typhi murium* (O) in 0·1 per cent. solution. All these compounds are practically inactive against *C. xerosis*. Phosphanilic acid was found to give, in another experiment, a 5 mm. with a concentration of 0·01 per cent.

As phosphanilic acid was found to be the most active substance it was tested for bacteriostatic activity in peptone and peptone broth at various concentrations with *Typhi murium* (O), *E. coli*, *Staphylococcus aureus* and Boyd II. The following table gives the results :—

Klotz and Morrison[1] mention that Kuhn, Moller and Wendt[4] have tested the antibacterial activity of phosphanilic acid but unfortunately the details of this work have not been available to us uptil now.

TABLE III
Inhibitory activity of Phosphanilic Acid on organisms grown in peptone and peptone-broth

Organism	Concentration			Control
	1:1000	1:5000	1:10,000	
E. coli ..	+	++	+++	+++
Staphylococcus aureus	+	+	++	+++
Typh Murium (0) ..	+	+	++	+++
Boyd II ..	±	+	++	+++

We thank Mr. H. L. Spindler and Dr. B. B. Dikshit, Dean of the B. J. Medical College, Poona, for their advice and active help and Dr. V. N. Patawardhan, Director, Nutrition Research Laboratory, Coonoor, for suggesting this problem to us.

Further work on analogous compounds containing phosphorous is in progress.

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Maharaja Pratapsinh Chemical Lab.,
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April 30, 1947.

1. Klotz and Morrison, *J.A.C.S.*, 1947, **69**, 473. 2 Bhide and Limaye, *Proc. Ind. Sci Congress, 34th Session*, 1947. 3. Heatley, *J. Biochem.*, 1944, **28**, 61. 4. Kuhn, Moller and Wendt, *Ber.*, 1943, **76**, 405.

FORMATION OF COMPLEX COMPOUNDS BETWEEN LEAD NITRATE AND ALKALI NITRATES—PART V
(Magnetic Susceptibility Measurements)
The System KNO_3– $Pb(NO_3)_2$ H_2O

A SURVEY of the literature shows that there is need for a detailed study of the systems: Alkali nitrates-lead nitrate-water, with a view to obtaining evidence for the formation or otherwise of complex compounds between the two salts. The work now in progress[1] has indicated that while $NaNO_3$ shows little tendency for the formation of complex compounds, KNO_3 and NH_4NO_3 appear to give rise to at least three compounds of which only one has been known or suspected before.

We report here the results obtained from magnetic susceptibility measurements made with a modified Decker balance.[2] In this instrument, a test body, a half-inch glass rod, is rigidly attached to the centre of a thin long rod whose other end is fixed to a quartz fibre mounted to a torsion head. The readings are taken in somewhat the same manner as with the Curie-Wilson Balance.[3] The test piece hangs horizontally inside a glass tube, with inlet and outlet for introducing and withdrawing liquids, fixed in position between the poles of the electromagnet. The glass container has a jacket in which water circulates from a thermostat, and thermometers at the inlet and outlet for noting the temperature of water.

The importance of constant temperature has not been appreciated by some workers, who seem to think that because diamagnetic susceptibility is independent of temperature, there is no need for thermostatic conditions. The fact is that the equation for the calculation of susceptibility contains terms which are very much dependent upon temperature, *viz.*, the susceptibility of air and density of the liquid; and unless the temperature is kept constant we may get different values for these at different temperatures, and the diamagnetic susceptibility calculated is bound to be different under different conditions of measurement. (We are emphasizing this apparently obvious point as one of the present authors was an innocent victim of such uninformed criticism by a referee.)

A current of two amperes in the electromagnet gave the required field strength which was kept constant during each observation. The solution needed for the experiment was 25 c.c. The formula used to evaluate the susceptibility was:—

$$\chi_{soln} \cdot \rho_{soln} = \chi_{\omega}\rho_{\omega} + (\chi_{\omega}\rho_{\omega} - \chi_a\rho_a)\,\frac{\theta_{\omega} - \theta_{soln}}{\theta_a - \theta_{\omega}}$$

(where χ is the susceptibility, ρ density, θ the deflection, the subscripts ω, a, denote water and air).

The working of the apparatus was checked by making determinations of susceptibility of liquids of known values, taking water as reference substance with $\chi = 0{\cdot}72 \times 10^{-6}$.

The following values were obtained for benzene and acetic acid:—

	Expt.	I. C. T.
Benzene	$-0{\cdot}711$	$-0{\cdot}712$
Acetic Acid	$-0{\cdot}522$	$-0{\cdot}521$

SOLUTIONS

Molar solutions of $Pb(NO_3)_2$ and KNO_3 were prepared. 20 c.c. KNO_3 solution was made up with the requisite quantities of $Pb(NO_3)_2$ solution in a 60 c.c. measuring flask and the solution made up to the mark (60 c.c.) with water. In this way 25 solutions were made in which the concentration of alkali nitrate remained the same, namely 1/3 M, while that of $Pb(NO_3)_2$ varied systematically from 0·0 M to 2/3 M.

OBSERVATIONS

The glass rod and container are successively cleaned with chromic acid, distilled water, conductivity water and alcohol, and then allowed to dry. The readings for air and water are repeated before and after the observations are made with a set of solutions. The mean of three readings is taken for each calculation. The values of χsol are then plotted against the concentration of lead nitrate, that is, against the number of c.c. of $Pb(NO_3)_2$ added to 20 c.c. KNO_3.

The curve (Fig. 1) indicates 3 breaks at 5, 10 and 20 c.c. of $Pb(NO_3)_2$. When plottings are made with "the change of χ per c.c.," the periodicity of the curve is brought out more prominently. The ratios of concentrations of the two salts at the points of inflexion correspond to the compounds:—

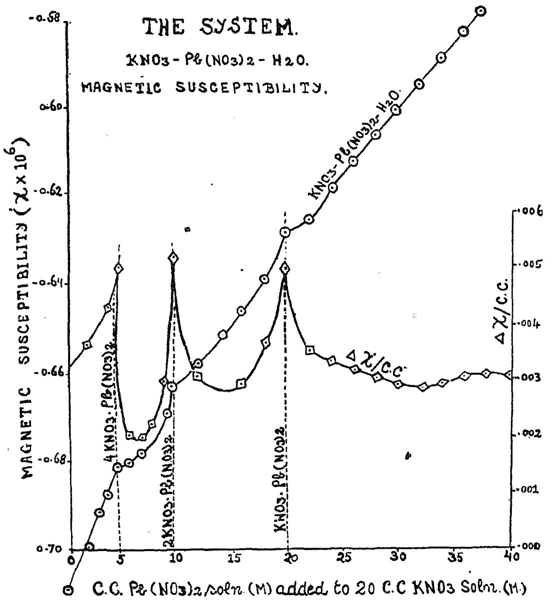

FIG. I.

$4KNO_3 \cdot Pb(NO_3)_2$; $2KNO_3 \cdot Pb(NO_3)_2$; and $KNO_3 \cdot Pb(NO_3)_2$.

Similar experiments with the system:

$$Pb(NO_3)_2–NH_4NO_3–H_2O$$

yielded analogous results. Here also the evidence for the formation of three compounds is unequivocal, *viz.*,

$4 NH_4NO_3 \cdot Pb(NO_3)_2$; $2 NH_4NO_3Pb(NO_3)_2$; and $NH_4NO_3 \cdot Pb(NO_3)_2$

Thus diamagnetic susceptibility is a property which can be classed along with other physico-chemical properties like viscosity, surface tension, conductivity, freezing point, E.M.F., etc., for the investigation of complex formation in solutions.

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M. R. NAYAR.

Depts. of Physics & Chemistry,
Lucknow University,
Lucknow,
June 14, 1947.

1. Nayar and Pande, *Indian Sc. Cong. Abst.*, 1947, **4**, **19**. 2. Mathur, *Ann. der. Phys.*, 1926, **79**, 324. 3. *Proc. Roy. Soc.* A, 1920, **96**, 429.

ERYTHROCYTE PYROPHOSPHATASE

PHOSPHATASES of animal tissues (bone, kidney, intestinal mucosa, plasma, etc.) acting on various phosphoric esters have been extensively studied but those of erythrocytes have not been investigated in detail. Roche[1] studied the distribution of such phosphatases in the red and white blood corpuscles and plasma. Jenner and Kay[2] have reported the activation of erythrocyte phosphatase magnesium. Recently the acid-phosphatase of R.B.C. was investigated by King *et al.*[3] and the erythrocyte alkaline-phosphatase is being further investigated by Patwardhan and Ranganathan.[4] But so far the pyro-phosphatase of R.B.C. has not been investigated.

The presence of pyrophosphatase in animal tissues was first demonstrated by Kay[5] and later mentioned by Roche.[1] We found that laked R.B.C. exhibit a weak pyrophosphatase activity, which is enhanced nearly hundredfold by adding Mg-ions to the reaction mixture. The enzyme shows maximum activity at the pH range of 7·6–7·9, and it shows great resemblance to the yeast pyrophosphatase.[6]

Experiment.—A measured volume of erythrocytes, washed twice at the centrifuge with normal saline, is hæmolysed and diluted with distilled water to 10 volumes. 0·5 ml. of the hæmolysate is incubated at 38° C. with 0·5 ml. sodium pyrophosphate (M/100), 0·1 ml. $MgCl_2$ (M) and 3·9 ml. M/35 Veronal-acetate buffer (pH 7·6). After 30 minutes the reaction is stopped by adding 2·5 ml. of 10 per cent. trichloracetic acid, and filtered after 5 mins. The ortho-phosphate present in the filtrate was estimated by Fiske and Subbarow's method.[7] Wherever necessary the ortho-phosphate is precipitated as the 8-hydroxy-quinoline salt and then estimated.[8] The marked activating effect of Mg-ions on the enzyme is shown in Table I.

	Mgm. P liberated per 1 ml. R.B.C. in 30 mins.
Without added Mg	0·024
With added Mg	1·370

Thus Mg-ions which are reported to inhibit the acid-phosphatase of R.B.C.[8] and activate the alkaline phosphatase of the R.B.C.[2] activate the erythrocyte pyrophosphatase to a very great extent. With 0·001 M. concentration of Mg˙ (qMg 3) the activation is almost nil, but 50 per cent. activation is obtained with 0·005 M. Mg (qMg 2·3) and 70 per cent. with 0·01 M. (qMg 2) and 100 per cent. with 0·05 M. Mg (qMg 1·3).

Plasma shows very weak pyrophosphatase activity even in the presence of Mg. The erythrocyte pyrophosphatase of sheep's blood is much weaker than that of human blood. As in the case of erythrocyte alkaline phosphatase such differences may be a characteristic of the species.

Further work on the properties and purification of the enzyme and its variation in health and disease will be published elsewhere.

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Vizagapatam,
May 8, 1947.

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ANTISEPTIC CULTURE OF RAGI (*ELEUCINE COROCANA*) SEEDLINGS, AND THEIR RESPONSE TO VITAMINS

In connection with our studies on the effect of vitamins and amino acids on the growth of seedlings and excised root tips, Ragi (*Eleucine corocana*), a highly nutritious millet and staple food in Mysore, was chosen as the experimental material.

Aseptic culture of seedlings and roots was an essential prerequisite for these experiments. The method of sterilisation as advocated in literature using various chemicals such as mercuric chloride, bromine water, calcium hypochlorite, etc., proved unreliable and unsatisfactory.

The micro-crevices of the rough testa offer an ideal lodging place for the bacterial spores; the waxy coating of the testa and of the associated spores resist wetting and prevent an effective sterilisation of the seed coat. Pre-treatment of seeds with a fat solvent, *e.g.*, ether, would render the testa wettable and facilitate the sterilising action of the antiseptic.

Optimum conditions of treatment were experimentally determined as follows:—The seeds (*Eleucine corocana*) were treated in the following order:—

(1) With tap water by rubbing them between fingers; next with distilled water. This helps removal of extraneous matter.

(2) Twice with 5 ml. portions of absolute alcohol, each wash lasting 5 minutes to remove the water and facilitate dissolution of fat or wax.

(3) Quickly with ether (5 ml.) to eliminate the waxy coating rendering testa readily wettable.

(4) With sterile water to remove ether.

(5) With 5 ml. of hypochlorite solution for 30 minutes.

(6) With sterile water to ensure removal of all traces of hypochlorite at this stage. A few seeds (sample I) for testing were transferred with a pair of sterile forceps into sterile petri dishes furnished with sterile filter sheets moistened with nutrient solution.

Treatment with hypochlorite for 30 minutes (1 hour in the final treatment) and washing with water was repeated seven times, and after each treatment a portion of the sample was tested for sterility.

All the seven samples were grown for five days. The rate of growth and degree of sterility are tabulated below (Table I).

Samples 1, 2 and 3 are not completely sterile, but the 4th, 5th and 6th samples are. The roots of the 7th sample soon turn brown and eventually die. The 4th sample shows quickened germination and the most lush growth. Thus the optimum conditions for aseptic cultures seem to be a minimum for treatments with hypochlorite with alternating washing. But this schedule may not be universally applicable, as the nature and susceptibility of the seed coat, the resistability of the endosperm and the activity of the antiseptic naturally differ from sample to sample.

Such excised sterile roots from petri dishes were then cultured at 28° C. for five days in tubes containing 5 ml. each of the following media:—Complete medium, basal medium, -glycine, -thiamin, -pyridoxin and -nicotinic acid media. The response in each case is shown in Table II.

TABLE I

Growth on	Sample I	Sample II	Sample III	Sample IV	Sample V	Sample VI	Sample VII
2nd day ..	—	—	+	+	+	+	+
3rd day ..	+	+	++	++	++	++	++
4th day ..	+	+	+++	+++	+++	+++	++
5th day ..	+	+	++++	++++	++++	++++	++
Degree of Infection	100·0	100·0	50·0	0·0	0·0	0·0	0·0

TABLE II
Growth of excised roots in different media

Media used	Complete medium (B.M. + B_1 + B_6 + glycine + Niacin)	Basal medium (sucrose + salts)	—glycine	— thiamin	— pyridoxin	—nicotinic acid
Percentage of increase in length after 5 days	41·66	66·66	46·1	66·66	61·6	41·6
Average increase/root in length	3·0 m.m.	5·25 m m.	4·5 m.m.	5·25 m m.	3·3 m.m.	2·8 m.m.

As seen from the table the excised roots of Ragi seedlings can grow well in a basal medium of sucrose and inorganic salts. Since they can synthesise their own vitamins, they do not require an external supply of any of the vitamins tested. This observation also explains

why Ragi can flourish in soils where many other plants cannot thrive.

My thanks are due to Mr. M. Sreenivasaya for guidance in these studies.

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Bangalore, (MISS) K. PADMASINI.
June 13, 1947.

AEROBIC SPORE-FORMING BACTERIA IN BOILED MILK

GROUPS of aerobic spore-formers in milk have been described by foreign workers.[1-4] Since milk is generally boiled in India a knowledge of the distribution and characteristics of the aerobic spore-formers present in indigenous samples of milk is of practical importance. In the course of studies on organisms associated with spoilage of boiled milk, the authors have isolated and studied the characteristics of a number of strains of aerobic spore-formers from samples of milk collected from various sources.[5] The most frequently occurring strains mainly responsible for the deterioration of boiled milk seems to fall under four distinct types.

The organisms included under the first three types are mesophiles with their optimum temperature at 40°-45° C., and maximum at 55° C. They are gram positive, highly motile rods forming central to sub-terminal oval spores; they are able to utilize nitrate as a source of nitrogen and produce ammonia both from peptone and nitrate broths; they ferment dextrose and sucrose with the production of acid but no gas. Indol is not formed by any of them. On the basis of its morphology, characteristic growth in laboratory media and action on milk the first type bears a close resemblance to *B. subtilis* Cohn., except for its inability to ferment maltose and hydrolyse starch and its higher optimum temperature, *viz.*, 45° C. It does not produce acetyl-methyl-carbinol in glucose phosphate water, but it is actively proteolytic, turning milk alkaline and peptonising it within 24 hours, often without showing any apparent signs of curdling. The change is sometimes detected only after close examination. The second type resembles *B. cereus*, Frankland, in most respects. It ferments maltose but does not produce acetyl-methyl-carbinol; and starch hydrolysis is slight or doubtful. Milk is curdled and proteolysed by it within 24 hours; and the curd is completely peptonised in three days. The third type, which is a lactose-fermenter, corresponds to *B. albolactis* Migula. It ferments maltose and also produces acetyl-methyl-carbinol, but starch is not hydrolysed to any appreciable extent. It forms a firm acid curd with slight whey formation within 24 hours at 27°-30° C. and thereafter the curd is slowly proteolysed. When growing in boiled milk the proteolysis is more rapid.

The fourth type appears to be an obligate thermophile with its optimum at 60°-63° C. and growth range extending from 50° to 80° C. It is a gram negative and sluggishly-motile rod forming terminal, ellipsoid to cylindrical spores. It reduces nitrates to nitrites; produces ammonia only from peptone broth, and does not form indol or acetyl-methyl-carbinol. It ferments dextrose, sucrose, salicin and sorbite but not maltose or lactose, and hydrolyses starch. It resembles *B. kaustophilus* Pricket, except in its reaction to Gram's stain. This type is comparatively less frequent and does not grow at ordinary temperatures. When boiled milk is kept at elevated temperatures (above 50° C.) it can grow well, slowly peptonising the milk, and when the temperature is near its optimum (60°-65° C.) a rennet curd is produced in 24 hours which is gradually digested.

The heat resistance shown by the above organisms even in broth and milk cultures (which are expected to contain only vegetative forms) appears to be remarkably high. The organisms of Type I are killed only after boiling for 10 minutes, and of types II and III after half an hour. But Type IV survives all these treatments. When pH is brought down to 6·0 by the addition of lactic acid, Types I, II and IV are killed by boiling for 5 minutes, but Type II survives even boiling for 10 minutes, and curdles milk in 24 hours. After they are grown in milk for 4 hours in association with pure cultures of organisms like *B. coli*, *S. lactis*, and *L. bulgaricus*, only Types I and III survive boiling for 10 minutes.

Imperial Dairy Research
Institute, Bangalore, KERALA VARMA.
July 12, 1947. H. LAXMINARAYANA.

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IS THE MACRONUCLEUS OF CILIATES ENDOPOLYPLOID?

ENDOPOLYPLOIDY was recently demonstrated in fermenting yeast cells.[1] The question arose whether, in spite of the different evolutionary origins of yeasts[2] and Protozoa, similar phenomena occur in other unicellular organisms? Since endopolyploid nuclei usually have no genetical future at all, one is naturally attracted to the macronucleus of Ciliates, which has been supposed to subserve a purely physiological function.[3,4]

The macronucleus takes its origin from the micronucleus and its nuclear nature itself is inferred only because of its above origin. It divides at every vegetative division, usually by amitosis, and disintegrates after a varying number of divisions, being regenerated either by endomixis or by division of the synkarion after conjugation.

It is this necessity for the renewal of the macronucleus from time to time that has led to the supposition that it controls the physiological functions. Sonneborn[4] concludes that while the macronucleus is essential and indispensable since it controls the physiological activities of the cell, the micronucleus could be lost with impunity.

Though the structure and behaviour of the macronucleus has attracted considerable attention, Protozoologists do not seem to have cared to consider whether it is endoploid. Long

before the discovery of endopolyploidy, Wenyon[3] describes a great increase in the number of granules, assumed to be chromatin, during division of the macronucleus and remarks that "there must have taken place a remarkable increase in the chromatin during its formation and growth from the micronucleus from which it was originally derived" (p. 61).

In his very interesting paper on "Gene Action in Paramoecium", Sonneborn[4] describes the compound nature of the macronucleus without realizing that the description is typical of endopolyploidy. He says: "As set forth above, the macronucleus arises from the syncaryon as a simple diploid nucleus. It then grows enormously, becoming a multiple nucleus containing at least 30 units, each with a complete diploid set of genes ... At times of fertilization, the compound macronucleus falls apart into its component units and these are resorbed in the cytoplasm" (pp. 216-17).

There are some other interesting observations by Sonneborn confirming its endopolyploid nature. The fragments of the macronucleus undergo a fourfold increase while the new macronucleus is developing into a compound structure and it appears that the division of the new macronuclei could be suppressed experimentally. As a result individuals are produced with no macronuclei at all at the end of the second post-zygotic division. In such cases Sonneborn observed the passive distribution of the pieces of the old macronucleus during vegetative divisions. These instead of getting resorbed, develop into compound nuclei and thus at the end of a number of divisions each Ciliate comes to have only a single macronucleus.

It appears likely that the chromatin granules seen inside the macronucleus may be the heterochromatin and using these as indicators—as done by Geitler[6]—it may even be possible in favourable material to study not only the variations in the degree of endopolyplody during the growth of the macronucleus to its adult size, but also after vegetative divisions.

Endopolyploidy in the yeast, therefore, does not appear to be an exception to the general rule among unicellular organisms. The significance of endomixis has baffled investigators up till the present day. But the moment one accepts that the macronucleus is endopolyploid not only does its important role in the physiological control of the activities of the cells becomes clear, but offers also an explanation as to why it should be regenerated from time to time. The usual fate of endopolyploid nuclei is death and disintegration after varying periods of activity. Hence the necessity for regeneration.

I am very grateful to Sir J. C. Ghosh, KT., D.SC., F.N.I., for his active interest and encouragement and the Council of the National Institute of Sciences of India for the award of an Imperial Chemical Industries Research Fellowship.

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Indian Institute of Science,
Bangalore (S. India),
June 20, 1947. M. K. SUBRAMANIAM.

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A NOTE ON THE CHROMOSOME NUMBER IN *COLOCASIA ANTIQUORUM* SCHOTT.

THE reports of the chromosome number of *Colocasia antiquorum* Schott are conflicting. The diploid number was found to be 42 by Nakajima[1] and Janaki Ammal[2] and 28 by Asana and Sutaria.[3] Maeda[4] found $n = 14$.

The diploid number in a local variety, determined by me, is 36 (Fig. 1). Root-tips obtain-

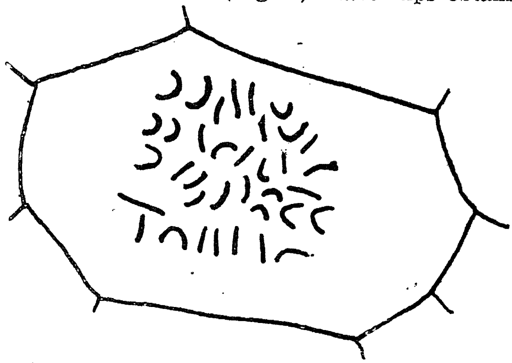

FIG. 1

ed from sprouting tubers were fixed in CrAF and stained with Genetian violet. As the drawing shows, chromosomes tend to be arranged in pairs, a form of 'somatic pairing' more marked at the periphery than at the centre.

Somatic pairing was first reported by Metz[5] in Diptera. Robertson[6] showed in *Paratettix* that somatic pairing occurred in diploid tissue of parthenogenetic individuals. In plants somatic pairing is reported in autopolyploids, as in *Iberis*[7] and *Cicer*.[8] The inference is that this *Colocasia* variety is an autopolyploid, and chromosome pairs are strictly homologous.

In vegetatively propagated plants polyploids and aneuploids tend to be preserved as races and varieties. The chromosome numbers reported by Nakajima and Janaki Ammal are multiples of 6. It is therefore probable that the variety with which these authors worked is a higher polyploid with the basic number 6. The material of Asana and Sutaria, and Maeda ppears to be neuploid.

I am thankful to Mr. S. Sampath for initiating the work and to Mr. K. Das for helping me in preparing this note for the press.

College of Agricultural Research,
Benares Hindu University,
Benares, N. SATYANARAYANA RAO.
June 16, 1947.

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REVIEWS

Hydraulic Measurements. By Herbert Addison. (Chapman & Hall Ltd., London), 1946. Second Edition, Revised. Pp. xii + 327. 158 diagrams. Price 21*sh.* net.

Just at a time when conservation of water and its multiple uses are engaging the special attention of engineers, the reappearance of *Hydraulic Measurements* in its second and revised edition is most welcome. It is an excellent reference book both to the Hydraulic Engineer and the Hydraulic Research worker. It is logically classified and arranged in such a way that it amply fulfils its avowed purpose, *viz.*, "to guide the reader quickly to the chapter wherein he may find methods likely to suit specific circumstances".

The first five chapters deal with the methods of measurement of fundamental units like Head, Pressure, Depth, Weight, Volume and Velocity, and the next seven with the measurement of the derived unit of discharge under varying conditions of engineering practice with a progressive increase in the quantities of flow. Chapter VI shows methods applicable to liquids flowing uniformly under atmospheric pressure and involving a drop in the level after passing through the measuring apparatus, like orifices and weirs. Chapters VII, VIII and IX deal with methods for flows under pressure along a closed pipe or conduit and include (*i*) quantity meters used in water-supply systems, (*ii*) Rate-of-Flow meters like Venturi and Pitot tubes, and (*iii*) special methods like Gibson's apparatus for Hydraulic turbines, Allen salt-velocity method, etc. Chapters X, XI and XII describe methods of gauging large streams and rivers by means of (1) free-flow methods like floats, current meters, etc., (2) artificial control sections like weirs and flumes and (3) regulating sluices in dams, barrages, etc., and by scale models. The final chapter is devoted to indicating, recording and integrating instruments for flow measuring installations.

From the point of view of facility of reference, we welcome the idea of putting the number of sections at the top of the page. To further increase this facility, we would suggest that to the section the number of the chapter also may be added, as *e.g.*, V § 84. Reference to figures may also show reference to the page on which they are found: *e.g.*, on page 185 a reference to Fig. 148 would have been quicker if page 285 were also mentioned along with it. In addition to subject index, an author index will also be useful.

As a reference book like this is to be comprehensive, it is suggested that the next edition may include the following:—

(1) Discharge over oblique weirs across rivers (anicuts in India);
(2) Discharge through Siphon Spillways (Saddle and Volute types) which are becoming increasingly used in India; and
(3) Automatic modules in irrigation distribution systems for giving constant discharge in spite of a limited range of variation in the head up-stream of the modules.

As the author admits in the Preface that there is bound to be a large divergence of opinion regarding the various appliances and methods of measurement, it is not proposed to give any opinion on this aspect. There is, however one point that I feel ought to be mentioned in view of its growing importance regarding the interpretation of results of model tests. On page 280, section 226 (iv), referring to round-crested weirs, it is mentioned that "comparative experiments have suggested that models of Ogee weirs have coefficients *greater* than those of the prototypes". The experiments in Poona (Indian Waterways Experiment Station) have indicated that the coefficients of scale models are actually smaller and a method is almost evolved to assess the coefficient of the prototype by extrapolation from the results of experiments on different scale models. As against this the experiments in Madras (Irrigation Research Station) and in our own laboratories (Hyderabad Engineering Research Labs.) seem to indicate that there is no large difference between coefficients of different scale models. In view of its importance this matter may be dealt with more fully in the next edition.

The bibliograhy is very useful. I think that there are quite a number of publications in India, specially of the Central Board of Irrigation, which may be usefully included in the bibliography.

In the introductory para (1) in defining the scope of the book, the measurement of velocity is omitted, which apparently must be a slip.

S. P. RAJU.

John Couch Adams and the Discovery of Neptune. By Sir Harold Spencer Jones. (Cambridge University Press.) Pp. 43. Price 2/- net.

The discovery of Neptune in 1846 is a story familiar to all students of astronomy and general science. The controversy regarding the priority of its discovery assumed almost international importance involving British astronomers on one side and the French on the other. Neptune was discovered independently by Adams in England and Le Verrier in France, in the sense that both accurately predicted the existence of the unknown planet and calculated its position, which later led to its identification. The claim for priority on behalf of the British scientist is that in point of date of working out the mathematics the credit should go to Adams, while the French claim refers to the date of announcement. The arbitration of Sir Roger deCoverly is most apt here, namely, that "much might be said on both sides".

Following the story in detail, however, does not bring a feeling of relief to any research student working under the conditions that Adams did. The latter was a victim of British

red-tape, conventions and formalities. It won't do if you have made a great discovery; you must also have a patron who would do the propaganda for you. Adams's important discovery did not get timely recognition, because, in the chain of circumstances operating against him, an attendant in the Royal Astronomer's household did not convey the proper message. Adams had to go away from the "Royal" door because the Astronomer Royal was either absent or at dinner. The Astronomer would not take Adams's paper seriously because he had received no reply to his letter containing some test questions. Poor Adams did not of course know that his fate was hanging on that reply. The Astronomer Royal began to take an interest in the subject only when he saw Le Verrie's article in the *Comptes Rendus*. Then the pendulum of "cussedness" swung from the Astronomer Royal to Challis, Adams's own Professor, who was entrusted with the very important work of exploring the sky for the unknown planet. The Professor took his work too leisurely for the world to wait for his convenience and narrowly missed the discovery more than once until the Berlin Observatory announced the important result far ahead of Cambridge. One cannot help feeling that Adams's own Professor let him down. That, however, is for the reader to judge.

We have in this pamphlet, presumably prepared as a centenary souvenir, a recapitulation and an authentic account of the circumstances leading to the discovery of Neptune and the subsequent controversy regarding the priority of discovery, illustrated with reproductions in facsimile of Adams's memoranda and a portrait. This account should serve as a constant reminder both to the research worker and his professor as to their respective responsibilities.

M. R. N.

Atomic Energy in Cosmic and Human Life. By G. Gamow. (Cambridge University Press.) Pp. xii + 161. Price 7*sh*. 6*d*.

This book is divided into three parts. In the first part, the author starts from the general ideas of atoms, molecules, etc., and develops the present-day views on the structure of atomic nuclei and atomic disintegration. The possibilities of the release of energy in nuclear processes and the conditions that must be fulfilled are most clearly brought out. This is followed by the second part in which the way in which stars use atomic energy is very clearly explained. In the last part, the possibilities of man using atomic energy are discussed.

The printing and get-up of the book is excellent and it is profusely illustrated with photographs, figures and sketches. The book is entirely descriptive in nature, and the attempts to explain mathematical ideas in a purely descriptive manner are admirably successful. Prof. Gamow has already made a name for himself in this direction, and the reviewer need not comment on this any further.

This is certainly one of the finest books on the subject available in the market. Students of chemistry need to know a good bit of nuclear phenomena, and this book is a real boon to them. The book can also be recommended as a text-book to B.Sc. physics students who cannot devote the necessary time to study more advanced literature.

S. V. Chandrasekhar Aiya.

Science in Industry. By A. M. Low. (Oxford University Press), 1947. Pp. 173. Price Rs. 2.

This book is the revised edition of the popular volume first published in 1939. The book gives a concise and lucid account of the peaceful applications of science. Beginning with the definition and correct exposition of Mass Production in modern industry the author describes the part science plays in the production of the most common and indispensable necessities of civilised life like food, transport, sanitation, entertainment and health. He has rightly exposed the fallacy commonly entertained against mass production; and the whole book is a powerful argument against the incrimination of science as the cause of war. In the author's own words, "the book shows how science enters into every phase of industry and how, whether we like it or not, we are dependent upon science during every minute of every day. To talk of 'abolishing' science or even controlling it is ridiculous. You cannot control or abolish a method of thought. What we can and must do is to control the manner in which scientific discoveries are used."

The value of the book for the general reader, the reviewer feels, would have been enhanced if the place of scientific research and unceasing investigation in modern industry had been illustrated in suitable places. It would keep the common citizen alive to the necessity of research in this age of democracy. The book is strongly recommended for students and the general public.

K. S. R.

Science Progress, Vol. 135, No. 138, April 1947. (Edward Arnold & Co., London), 7/6*d* net.

The current issue of this periodical contains original articles of interest in Geology, Stellar Physics, Pharmacology and Modern Algebra. Reviews and resumé of certain recent advances in general Physics and Biochemistry as well as in Botany, Plant Physiology and Entomology are included. Essay Reviews on *Binocular Matching* and *A New Organic Chemical Notation*, and reviews of recent science publications are, as usual, interesting features of the Journal.

PUBLICATIONS RECEIVED

Scientific Institutions, Societies and Research Workers in the Netherlands Indies. (Copies can be had free of cost from the Editor, *Chronica Botanica*, P.O. Box 151, Waltham 54, Mass., U.S.A.)

Fuel Abstracts, New Series, Vol. I, No. 1, January 1947. (Compiled by the Intelligence Section, Fuel Research Station, E. Greenwich, London, S.E. 10.)

Fisheries Byeproduct Industries; Dermestes vulpinus F., an Insect Pest on Dried Fish; Decomposition and Putrefaction of Fish.—Lectures delivered by Dr. S. T. Moses, Director of Fisheries, Baroda.

Science, the Endless Frontier. By Vannevar Bush, Director, O.S.R.D., Washington.

SCIENCE NOTES AND NEWS

TECHNOLOGICAL STUDIES

The Government of India have set up an All-India Council for Technical Education to promote and co-ordinate technique. In order to attain a uniformly high standard of education and examination throughout the country the All-India Council has established six All-India Boards of Technical Studies in the following main branches of engineering and technology; Engineering and Metallurgy; Architecture and Regional Planning; Chemical Engineering and Chemical Technology; Textile Technology; Applied Art; Commerce and Business Administration.

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

The Government of India have decided to continue the existing constitutiton for the Council of Scientific and Industrial Research in view of the unanimous opinion of the members representing industry and science on that body. They have also decided to abolish from April 1, 1947, the Industrial Research Utilisation Committee which was an advisory body to assist the Council.

INDIAN INSTITUTE OF SCIENCE

Sir Ardeshir Dalal has been unanimously elected President of the Court of the Indian Institute of Science for 1947-48 in place of Sir M. Visvesvaraya who resigned from the presidentship of the Court owing to reasons of health.

REPORT OF PANEL ON COIR INDUSTRY

A drive for the improvement and expansion of coconut cultivation and for stepping up the production of coir in India is urged by the Panel appointed by the Central Government in respect of coir, rope, cordage and other fibre industries.

A target production of 229,125 tons of coir is specified by the Panel who suggest improved and mechanical methods in the retting of husks, proper grading of fibre and better communications in the coconut-producing areas. Coir can be easily impregnated with bituminatious and resinous materials, which provides a unique opportunity for exploiting its uses in many directions. The Panel emphasise that India should make fuller use of the raw material by retting all available husks and by establishing roperies in Travancore, Cochin, Malabar and Bombay so as to absorb more coir. The need for the establishment of Coir Textile Institute, preferably a co-operative organization of all producers in close association with Government, is also stressed.

The Panel recommend steps for growing sisal in India and duty-free import of manila and sisal fibres, a tariff on imported rope, financial assistance to the industry for research purposes and a reduction in the tariffs imposed by countries importing coir mats and matting.

PRODUCTION OF MANGANESE IN INDIA

A new process which will enable India to extract manganese directly out of her own stocks of manganese ore, of which she is the second biggest producer in the world, is described in the March issue of the *Journal of Scientific and Industrial Research*. The process which is worked out in the laboratories of the Indian Standard Metal Company, Ltd., Bombay, enables the extraction of the metal from ores and also electrolysis of Aqueous solutions to produce pure manganese.

VITAMINS FROM INDIGENOUS SOURCES

The Committee of the Technical Panel of the Food Department of the Government of India for the planning of vitamin production, has recently examined the question of the preparation of concentrates of vitamin A from shark liver oil, carotene from carrots, grasses and green leaves and vitamin C from common Indian fruits like *amla* and guava. It has suggested that vitamin C from such cheap sources as *amla* might be produced in the form of syrup taking care to preserve the vitamin content, and recommended that a certain proportion of edible oils and fats, provided they are not used for frying, could be fortified with carotene. These fortified oils could with advantage be given to the "Vulnerable sections" of the population.

CERAMIC INDUSTRY IN HYDERABAD

The Nizam's Government have sanctioned a scheme designed to develop ceramic industry at a cost of Rs. 12 lakhs during the first five years. A ceramic factory for the manufacture of crockery, insulators, sanitary wares, firebricks, fireclay, etc., will be established. The daily output is expected to be five tons of mixed crockery goods and insulators and 20 tons of firebrick and fireclay. The requisite materials are available in abundance in the State.

LINSEED OIL IN AUSTRALIA

A special variety of linseed oil, known as "Walsh" is to be produced in Australia. Contracts with flax-growers in several of the States for the supply of the necessary seed have been arranged by a leading oil marketing company. "Walsh" is resistant to rust, and there is an extensive world-wide market for the product. It is expected that in a few years Australia will be self-supporting in regard to linseed, imported from India at present.

DEVELOPMENT OF AMAZON TRACTS

Under the auspices of UNESCO a team of scientists, headed by Dr. E. J. M. Corner, are in Rio de Janeiro making preliminary studies for the establishment of an International Institute of the Hylean (Greek, for forestry) Amazon, probably at Para, Brazil.

Staffed by experts in all branches of science, the UNESCO Institute will study botanical, zoo-

logical, chemical, geological, meteorological, anthropological and medical facets of the area, as well as its potential habitability in terms of non-indigenous peoples.

Special attention will also be given by the scientists to medicinal products and other raw materials whose extraction may now be feasible with the use of modern equipment and methods. Explorers have pointed out that tribes in certain regions of the Amazon live totally free of cancer, raising the possibility that some element in their diet will provide a cure for the dread disease. The Amazon is also the largest forest region in the world, and its rubber resources are believed to be almost limitless.

MANGO-SEED KERNELS AS CATTLE FEED

Animal Nutrition workers at Izatnagar, India, report that mango-seed kernel forms a new source of valuable cattle feed, fairly rich in protein and carbohydrates. The feed is prepared by shelling the seed, slightly crushing the kernel and incorporating it up to three seers in the ration. The animals, after taking to the feed, gain weight and develop a healthy appearance.

SOVIET SCIENTISTS TO REPORT ON INDIA

"A Study of India" is the subject of a joint session of the History and Philosophy, Economics and Law, Literature and Language Departments of the Sovict Union Academy of Sciences which has opened in Moscow to discuss investigations of Soviet scientists in India's History, Literature and Economics.

The agenda of the session includes several scientific reports of economic consequences of the second World War for India, conditions of Indians in South Africa and the Asian Relations Conference in India which was held in March and April this year.

RESOLUTION AT CHEMISTS' CONGRESS

The Congress of Pure and Applied Chemistry at London, approved by acclamation the resolution sponsored by the Organic Chemist, Professor G. Morales Macedo of Peru.

The resolution said: "The eleventh International Congress of Pure and Applied Chemistry declare their wish that in future the science (chemistry) must be applied only to establish good relations and fraternity among different countries of the world."

B.H.U. COLLEGE OF TECHNOLOGY

Dr. Sadgopal has been appointed Professor of Oil and Soap Technology in the Department of Industrial Chemistry at the College of Technology, Benares Hindu University.

AWARD OF PH.D. DEGREES

The following research scholars have been awarded the degree of the Doctor of Philosophy :—

(1) Mr. O. Ramachandraiah (*Andhra*); (2) Mr. M. S. Muthanna (*Madras*); (3) Miss G. Sharada Bai (*Bombay*).

ERRATUM

Vol. 16, No. 6, June 1947, page 167: Article on "Technical Education in India": In the footnote *read* "Address by Mr. N. R. Sarkar" *for* "Address by Sir N. N. Sarkar".

AN APPEAL

EMERGENCY COMMITTEE OF ATOMIC SCIENTISTS

(INCORPORATED)

ROOM 28, 90 NASSAU STREET, PRINCETON, NEW JERSEY

April 30, 1947

DEAR FRIEND,

Through the release of atomic energy, our generation has brought into the world the most revolutionary force since prehistoric man's discovery of fire. This basic power of the universe cannot be fitted into the outmoded concept of narrow nationalisms. For there is no secret and there is no defence; there is no possibility of control except when the aroused understanding and insistence of the peoples of the world.

We scientists recognize our inescapable responsibility to carry to our fellow-citizens an understanding of the simple facts of atomic energy and their implications for society. In this lie our only security and our only hope. We believe that an infomed citizenry will act for life and not for death.

We need $1,000,000 for this great educational task. Sustained by faith in man's ability to control his destiny through the exercise of reason, we have pledged all our strength and our knowledge to this work. I do not hesitate to call upon you to help.

Faithfully yours,
A. EINSTEIN.

[*We are confident our readers will extend their hearty and generous support to Prof. Albert Einstein's Appeal.*—EDITOR.]

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Current Science

Vol. XVI] AUGUST 1947 [No. 8

INDIAN INDEPENDENCE DAY

THE FIFTEENTH OF AUGUST is of momentous importance in the national struggle for Independence of India. In the history of the world the day is of unique significance. For, unlike America and Ireland which achieved their independence through war and bloodshed, India has won her freedom through peaceful and yet more compelling self-travail. All thanks to MAHATMA GANDHI and the Spirit of the East, a new weapon worthy of civilised humanity has been forged for resolving conflicts between great nations. From this day onwards India attains her due status in the Councils of the world. We have reason to hope that her persuasive voice of Justice will quench for all time the threat of war among men.

For India herself, the fifteenth of August will always remain a day of prayer, and grateful remembrance of all the martyrs who struggled and laid down their lives for the righteous cause of liberation of India and all oppressed humanity. This will ever be a day of new hopes and of dedication to new efforts.

With a National Government installed in Delhi, Science enters on a new phase of development. As PANDIT NEHRU has rightly said, science alone can solve the problems of hunger and poverty, of insanitation and illiteracy, of superstition and deadening custom, of a rich country allowing its people to starve. If we are to come up on a level with sister states in the world, speedy progress is to be achieved both in basic and applied sciences. We assure our National Leaders that the enthusiastic co-operation of scientists is at the service of the Nation in building up an India worthy of the long-cherished dreams of her children. With the advent of freedom so much that seemed impossible only a year ago is now easy of achievement that we might not be considered too optimistic if we prophesy that the era has begun for India of peace and prosperity through scientific progress.

TRAINING OF POWER ENGINEERS IN INDIA

INDIA IS INDEPENDENT. In the wake of her independence will follow her industrial development and expansion. For the industrial expansion of India the Electric Power Development must receive its due importance. This importance has been acknowledged by the Government of India. In India's power development the training of Engineering personnel is undoubtedly one of the most important things that the country has to concern itself with. Hand in hand with the electric power development programme, provision must also be made for the training of the Power Engineers, for without trained personnel the great plans now under contemplation cannot mature. We are planning to increase the electrical generating capacity of India. It is planned to increase this by approximately four million kilowatts in the next five or six years. Only this small increase will involve more than trebling the number of her Electrical Engineers. With the enormous potentialities of development in this field existing in this country, an ever-increasing number of engineers will be essential. With the electrification, as existing industries grow and new industries are established, bigger demands for the engineering personnel will arise. Urgent and immediate attention, therefore, is to be given to the training of Power Engineers for our power developments, without whom our plans will not be possible.

The position of India in this connection is the same as what existed in Russia and Japan when they embarked on their electrical power development. Their first efforts were to train a large body of technical personnel. Now that we are moving to take measures in the development of our power resources, our first consideration should be directed towards the creation of technical personnel with specialised knowledge in this field. India must depend on her own nationals for specialists. Foreign help, which we might and would need at this stage, should only be the initial makeshift. To import foreign help would also be a costly affair as whatever can be obtained from other countries would only be by attractive remuneration, and/or by foreign interests. A number of foreign experts have been invited. In the initial stages, we might have to invite them in a larger number. A number of our young Engineers are also sent abroad for training. These young men, when they return, would form a nucleus of technical personnel, but a very small one. Again, the facilities for training accorded to our young engineers, whom we have sent abroad, are not what they should be. Numerous and repeated complaints are received from them. It has to be acknowledged that co-operation at this stage of the industrially advanced countries for the training of our students has to be sought. It is hoped that friendly gesture will arise. This, however, is not the aim. We must arrange to train our personnel ourselves; for a number of years engineering personnel will be required in large numbers in India. For the electrical development of India there is an immediate need of properly trained engineers with training in Power Engineering at a higher level than is now given in our Engineering and Technical Colleges. With the rapid increase in the electrical generating capacity in the country, unless proper trained engineers are soon available, it might easily create a main bottle-neck.

To this purpose, the authorities of the Indian Institute of Science prepared and sponsored a scheme for training of Power Engineers. This received the blessings of the Government of India. Thus came into being the Power Engineering Department at the Indian Institute of Science. This department will form a training centre for Power Engineers. In this department will be admitted engineering graduates from the Indian Universities. The course would be a post-graduate one of two years duration. The object of the course is to provide instructions in Power Engineering (Hydro and Thermal) so that the product of this course, after this training, immediately presents material for superior positions and fill them and discharge them with confidence. The graduates in Engineering in India when they emerge from their college courses do not possess sufficient knowledge and experience of power engineering, either in planning or operation. Adequate facilities do not exist in this country. The training proposed for the Power Engineers is to provide a training ground in India, which other countries like the U.K. and the U.S.A. have. The post-graduate power engineering department is, therefore, created for imparting specialised

training in power engineering to selected civil, electrical and mechanical engineering graduates, for producing adequately qualified engineers for power development, for electric supply industry, and also for large industrial undertakings having their own generation plant and/or electrical equipment.

The course will be divided into 3 sections of Power Engineering, Civil, Electrical and Mechanical. Civil engineering graduates will specialise in civil work of Hydro-Electric installations, Mechanical engineering grduates in Thermal Power Stations, Boiler House and Boiler House Economics, Fuel Research, and the Electrical engineering graduates in Electric power generation, transmission and distribution of power and its utilization. The theoretical training imparted to the young graduates will be of an advanced nature and so arranged as not to overlap or be of the same order or standard as the theoretical training which they have had in their Engineering Colleges. The students specialising in one of the above three branches will receive ancillary training in the relevant portions of certain subjects common to all the three branches which are considered essential for the proper all-round training of Power Engineers. Besides this, the training will also include preperation of co-ordinated designs and drawings and typical co-ordinated power projects.

The course will be divided into two periods of one year each. One year for the theoretical training on the above lines and one year in practical experience in their specialised subjects. Apart from an intensive course of training in the well-equipped laboratories and other plants of the Power Engineering Department (which will coincide with the theoretical training period), in the second year, outside practical training facilities will be arranged for the students with large private electricity supply undertakings, provincial authorities, and in other Government planned projects under construction. For professional engineers no such national training scheme exists. Nor is it realised generally that the degree of responsibility hitherto shown by the employer towards an apprentice trainee is almost nil. A number of cases exist where apprenticeship is exploited as a means of cheap labour confined in narrow limits and limited sections of the engineering works where they are sent. It is here that assistance will be sought from the Government to ensure and take such steps that, in the practical training and experience of these students, necessary facilities and latitude on a wider margin than hitherto acknowledged, will be given.

Considerable thought and importance has been given to laboratories, their equipment, and other plant. These consist of a well-equipped Thermal Power Station, Electrical Laboratory, Hydraulics and Hydro-dynamics Laboratory, Materials Testing Laboratory, Electrical and Mechanical Workshops, and a High Voltage Engineering and Research Laboratory. The Thermal Power Station will form the centre for providing the practical training. It will be equipped on modern lines and with reasonably adequate plant. The equipment in Hydraulics and Hydro-dynamics Laboratory will also provide means for special tests and research work on different problems. Materials Testing and Electrical and Mechanical Workshops will serve their own useful purposes. In the Electrical Laboratories is included an A.C. Network Calculator. This Calculator will be made available to other large electricity undertakings and Central Technical and Provincial Power Boards to solve their problems. This equipment will solve problems such as finding out fault currents at any point in a complicated and interconnected power system, best position for any new generating station and its installation, interference with communication lines, etc. The High Voltage Engineering and Research Laboratory forms a section of the Power Engineering Department. The equipment in this laboratory will be capable of producing a three million volt surge, one hundred thousand amperes current surges, and a million volt A.C. power testing.

The High Voltage Laboratory will serve needs for research, in special power problems, experimental work for transmission lines, and closely associate itself and render assistance to such allied subjects and industries. Arranged and co-ordinated with the power plant and the high voltage laboratory, there will be erected a length of overhead E.H.T. transmission line. Apart from the routine testing and operational work on this line, it would be used for experimental and research work for any special problems of the transmission line designers and engineers in India. In the

Power Engineering Department importance will be attached to research work. There is very small amount of engineering research being conducted in the Universities and Technical Colleges in India. Research would be made a prominent feature, and it should help the student to appreciate the attitude and technique of science in seeking to enlarge the realm of scientific knowledge and this attitude he must have if he is to be a creative Engineer.

The intentions also are to arrange and invite specialists and acknowledged experts in various branches of electrical engineering in particular reference to power generation and development, to give a course of lectures in their specialised spheres and problems. It is here that another course could profitably be arranged. A course of short duration for Professional Engineers which would serve as a Refresher Course, would be provided. The experts, who would be invited, will not be restricted only to this country but from other countries of the world—U.K., U.S.A., Russia and others. These experts would discourse on special problems which confronted them, the methods they adopted to get over their difficulties, and discuss with our engineers problems that might be confronting us and suggest from the light of their experiences possible remedies and solutions. With the birth of this new training scheme at the Indian Institute of Science, let us hope, would be born similar and many other scientific and technical training and research centres, and India would produce within herself her own Scientific and Technical Personnel, second to none.

M. S. Thacker.

INDUSTRIALISATION OF THE INDIAN CONTINENT*

SANKALCHAND G. SHAH

The geographic distribution of India's natural resources makes it clear that industrial and economic planning of the country should be a subject of the Federal Centre. In order to achieve a progressive economy a Central Planning Commission should be appointed immediately, as the A.-I.M.O. has already recommended, to evolve a 'single cohesive plan for the whole country by integrating all regional plans in close association with all Provincial Governments, States, and industrial organizations'.

The United Nations' Far Eastern Group, in a report issued by them, lists the following as the main obstacles which retard economic reconstruction in the Far East—political and social unsettlement; training and education of personnel; provision of capital; foreign exchange resources; equipment and materials; monetary disorders and inflation; basic consumer goods and services; and application of technology and research. I may say that these obstacles exist in this country also.

The industrial activity of India has increased only by about 15 per cent. during the last ten to twelve years. Russia by a determined planning of industries has increased its *per capita* income by 3½ times in ten years as a result of investing 4,700 crores of rupees in industries and 1,860 crores in transportation from the savings of the people. The *Bombay Plan* suggested that in fifteen years we could increase our national income by three times and double our *per capita* income by investing 3,475 crores in industries and 1,300 crores in transportation.

Five-Year Planning Advocated by Sir M. Visvesvaraya

Sir M. Visvesvaraya pleaded at the last Annual Conference that an annual investment of Rs. 300 to Rs. 500 crores should be sunk into new industrial enterprises *in the next five years* if the Industrial development of this country is to be a *fait accompli.* This advice of our veteran President—himself one of the greatest industrialists of India—must be acted upon in time, as by further indecision and theorising, valuable time will be lost, losing a start, that would enable Indian industries to brace themselves to meet foreign competition. Enough of "Paper Planning": we want concrete action.

Foreign Capital and Joint Ventures

I have stressed already the urgent need for the rapid industrialization and also the early necessity for planning the same. The

* Text of the Address by Mr. Sankalchand G. Shah to the All-India Manufacturers' Organization, 20th July 1947 at Bombay.

question now naturally arises, "Is sufficient capital available in the country to meet the needs of our industrial development?" I submit this is a matter of utmost importance to the country as a whole and should be tackled forthwith.

I believe there is not sufficient capital in the country for any large-scale promotion of heavy and key industries. There is a fairly large amount of hoarded wealth in the country. I am of the opinion that for some years to come at least the general public will hesitate to invest their capital readily in new ventures as we lack technical experience and the "know-how" of production at present. Confidence could be created in the public if foreign technical co-operation can be secured. It is, therefore, essential to invite both foreign capital and technical co-operation for starting heavy and key industries in India at least during the next few years. While it may be preferable to obtain foreign capital mainly in the form of loan, I am of the opinion that it will be more advantageous to start joint ventures with the co-operation of foreign industrialists. This question of Joint Ventures was personally discussed by me with many foreign industrial and business leaders while I was abroad recently as a member of the A.-I.M.O. Delegation. Most of them agreed that in all such joint enterprises the controlling interest should be predominantly Indian and that management also should be entirely in Indian hands. The share capital to be supplied by Indian industrialists and the foreigners may be, say in the ratio of 60 : 40 or thereabouts. The foreigner would subscribe his share of capital in the form of capital goods, machinery, services and supply of technical information. The Indian industrialist would subscribe his share in the form of buildings, labour, management, working capital, etc.

State and Private Enterprise

There is, however, one obstacle in this connection. There is a growing suspicion in the mind of many foreign industrialists and technicians that the National Government of India may nationalise large-scale industries in the course of the next few years. This suspicion may be baseless, but it is there, and early steps should be taken by the Government to remove it. I do not propose to go into detail on this question of relation between State and private enterprise as it was fully discussed at our last Annual Conference at Delhi. I welcome in this connection the Hon'ble Pandit Jawaharlal Nehru's statement: "In the present stage there will have to be inevitably a great deal of private enterprise. I do not want to interfere with them. But if you are going to plan, even these private enterprises must function within that plan."

German Experts

I now turn to the very important subject of securing first-rate experts for starting and running our industries. As a result of my personal investigations while abroad, I am of the opinion that it would be highly advantageous for us to have experts from Germany. Experts from other countries such as the U.K., U.S.A., or Continental Countries are not generally available due to the demand in their own countries for post-war reconstruction, or even if available, can be secured only on very high salaries. Further many of them will not like to stay in India for any length of time and will at least like to return to their country at intervals, and this will naturally prove very costly. In the case of German experts they are willing to leave their country and settle in India, as the future of Germany is more or less sealed at least for the coming twenty to thirty years, and as they are not hopeful of their future in their own country. I, therefore, urge that it be taken up with the Government of India immediately, and that they be moved to secure for industrialists the services of the best available technical experts from Germany.

Capital Equipment

I would also like to refer in this connection to the question of obtaining capital equipment for our industries. We have pressed the Government of India on so many occasions that there should be the fewest possible restrictions on the import of capital goods from abroad. Partly as a result of this agitation, I am glad to observe that the Government of India have revised their import policy. In their Press Note, dated 16th May 1947, they have announced that licences for importing a number of types of machinery and certain essential raw materials will be granted freely. While I welcome this, I regret to note that automatic revalidation of licences, which expired on the 30th June 1947, has not been permitted in the case of capital goods, though the same has been done in the case of a number of other articles. I find no valid reason for this

discrimination and, therefore, urge upon the Government of India to remove it forthwith. As regards obtaining capital goods, I would like to make a suggestion. Till now the country has been looking forward to the U.K. and the U.S.A. mainly for obtaining its requirements of capital goods. There are good prospects for obtaining the same from Continental countries such as Sweden, Switzerland, France, Belgium, Czechoslovakia and others, and I would like to urge that they be explored and availed of immediately. Furthermore every effort should be made for obtaining India's share of reparations from Japan mainly in the form of capital goods. Before I conclude this subject of capital goods, I would like to stress that special attention should be paid to the local manufacture of machinery with the aid of foreign experts where necessary. In the beginning the quality of such machinery may not be high or quite up to the standard, but with the passage of time and with Government's support and encouragement it is bound to improve.

Taxation

I now pass on to the subject of Taxation. At present the Indian industries are subject to an intolerable burden of taxes. If this continues, I do not know from where will Companies and individuals get money to build, equip or expand their activities. I, therefore, submit that the present severe rates of taxation should be revised and reduced, and part of the money now flowing to the Government Treasuries from industries should be diverted to its most fruitful and productive channel, *viz.*, the development and maintenance of industrial enterprises. This step is necessary if Indian industries are to carry on successfully in the future when more competitive conditions will prevail and also to undertake the expansion which is contemplated under various post-war industrial expansion schemes. I would like to make a suggestion in this connection. During the course of discussions in the Central Legislative Assembly, the Hon'ble the Finance Member assured that a Committee of Experts would be set up to examine the provisions of the Income Tax and E.P.T. (Amendment) Act, 1947, and to make recommendations to Government to remove the difficulties in the Act and to suggest how Government could make it more effective and easy to administer. This Committee has not so far been set up by the Government, and I urge that it be done without any further delay and that representatives of Industrial Organizations like ours should be included in the same.

Research

Another important problem facing the Indian industries is that of provision for industrial research. Under the urgent and pressing needs of War, new types of machines and materials which were not dreamt of formerly have been discovered. Progress in industrial research is vital to India. Our country has vast and varied resources of wealth, but they will be useful only if they are made to serve industrial needs. I am glad to note that our National Government is alive to this desideratum. Provision has already been made for starting a number of research laboratories in the various parts of the country, and I am confident that we may expect further progress in this line in future.

Import-Export Controls

I have often criticised in the past our Government's import-export control policy which hampered the growth of indigenous industries. I have also urged that the best possible use of India's foreign exchange resources should be made by restricting the import of some consumer and non-essential goods. In the Press Note on Import Trade Control issued by the Government on the 16th May 1947, I notice with satisfaction that there has now been a marked change in Government's policy. It has been announced that no licences would be granted for about 350 items. Another welcome announcement already referred to is that henceforth licences for import of capital goods, machinery, and certain essential raw materials will be granted freely.

Labour-Management Relations
Stepping up Production

Industrial Production to-day is at a low ebb; and with it an ugly mark has been left on industry, on its Labour and Management. On account of increase in prices and lack of sufficient food a demand of a revolutionary type from labour is taking place in the industrial organization of the country. Demand for higher wages and less number of working hours is the cry to-day. The management who have tried to meet their demands to a great extent have to view their new problems with grave concern. The future *labour-management* relations must be conceived from the background of world movements. The A.-I.M.O. has advised the manufacturers time and again to

adopt a more liberalised programme and constructive action in the general interests of the country, while balancing legitimate interests of the labour and management. In doing this we should also consider the legitimate rights and privileges of the technologist and the scientist and not ignore them.

It is high time that Government concentrate on an all-out effort to step up industrial and agricultural production. The Commodity Prices Board recently set up by the Government of India to advise them regarding fixation and control of prices, in its report to the Government, present a grim picture for the next few years. They see little prospect of increase of the agricultural output per acre for the next three years, India's dependence on foreign foodstuffs for some more years resulting in the diversion of purchases of capital equipment. This would result in hindering industrial production. It is desirable, therefore, that the Government maintain the price at a level, and there should be no further increases except in special cases where they find it absolutely justifiable.

VILLAGE INDUSTRIALIZATION

The A.-I.M.O. has put forth a well-conceived and scientifically planned village industrialization scheme, so that India can have units of groups of villages with a prosperous economy. If the scheme is taken on hand and put into operation immediately by the Government or the people of the rural areas or by public organizations, the villages will become self-sufficient in course of time with regard to food-stuffs and other commodities.

HEAVY INDUSTRIES

Before concluding my remarks I may once again appeal to all progressive people of this country to co-operate in the programme of the A.-I.M.O. for the early establishment of at least a few Heavy industries in the country. The A.-I.M.O. has published a scheme for an all-round development of Heavy Industries in the country. The Government should assist in the establishment of heavy and key industries and provide facilities for the *entrepreneurs* to go ahead with their plans. With the growth of large-scale and basic industries innumerable secondary or medium and small-scale industries would automatically grow.

Let me also take this opportunity to urge upon both the Government and the people to strive for a common basic educational system at the primary and secondary school-leaving stages, with a view to creating a spirit of nationalism and nationhood from the early days of training so that the future citizens would think and act as one nation.

Note.—The cost of printing this article has been met from a generous grant-in-aid from the National Institute of Sciences of India.

BRITISH FISHERY RESEARCH IN ARCTIC OCEAN

THE British Ministry of Agriculture and Fisheries have decided to resume intensive research in fisheries in the vast waters of the North Sea and the Arctic Ocean.

The Fisheries Laboratory at Lowestoft, a port on the East Coast, will soon be given to operate with three research ships under the direction of Michael Graham, one of the greatest authorities in deep-sea fish research.

Two of the ships are used for exploring home waters, tracing the drift of plaice eggs from the spawning grounds to the areas where the eggs develop into young fish. In addition, the trawler undertakes the preparation of charts on which is marked the concentration of both zoo- and phyto-plankton, important with regard to herring fishing.

The collection of samples of fauna on the sea bed helps to discover what it is that fish live on and, for this purpose, the *Sir Lancelot* makes use of a "grab". Study of the fauna supplies valuable knowledge as to the way in which fish feed.

The second research ship will be shortly put to sea in connection with the pelagic fishery, *i.e.*, surface fishery for herrings, sprats and pilchards.

Entirely new ground will be broken when the research ship *Ernest Holt*, to be completed beforelong, starts off for the Arctic waters. Her fittings include a large laboratory, a testing fish room with a capacity of 40 tons, a submersible electric plankton pump, sounding apparatus, as well as many scientific instruments, together with a new refrigerating plant. The ship's hull will be made specially resistant to pack ice.

The waters in which the *Ernest Holt* will operate lie between Spitsbergen, the Boar Islands and the Barents Sea. The ship will be used to explore among other things, the mixing areas of cold and warm ocean currents, and also to discover how they affect the movements of fish.

Scientists expect from these studies to discover why certain fish are met with in certain waters and not in others. The research work of the fishery naturalist ultimately aims at balancing the fishable stock. A check has to be put on the rate of fishing, and the research aims at fixing the maximum rate. Recommendations from the Lowestoft Fisheries Laboratory are reported to have already served as a basis for international negotiations which, it is hoped, will lead to a more rational exploitation of the sea as a rich source of food.

THE VANASPATI PROBLEM

V. SUBRAHMANYAN AND S. S. DE
(*Department of Biochemistry, Indian Institute of Science, Bangalore*)

DURING recent months, a great deal has been said and written on the subject of Vanaspati. Very little of fresh scientific evidence has been adduced, but the public mind is greatly agitated following the publication of varied statements and reports regarding the nutritive value of the product and its possible effects following continued usage as an article of food. The publications come in three categories:—(*i*) expressions of opinion by different consumers which, though not strictly scientific, are still entitled to respect because they are based on actual experience; (*ii*) general statements reported to have been made by scientific workers and which have been cited for or against the industry; (*iii*) letters and summaries bearing on previous work on the subject and which are now appearing in scientific journals. None of these has proved conclusive. The opinions of consumers are divided, the general trend being in favour of a cautious approach, pending definite and conclusive scientific evidence. The statements by scientific workers and important Government members are often misquoted with the result that in some cases the persons concerned have themselves been obliged to issue subsequent corrections and contradictions. On the whole, the general trend of opinion is in favour of reserving judgment pending the collection of more evidence in regard to the various aspects of the subject.

The Vanaspati industry in India is of comparatively recent origin, having started from small beginnings in the early thirties. The product soon gained in popularity as there was a demand for a cheap preparation with a similar appearance, taste and flavour which could wholly or partly replace ghee as a cooking medium. The turn-over increased from year to year and the manufacture now ranks as one of the major food industries in the country. The capital and the equipment already engaged may be valued at twenty crores of rupees and the annual production at about thirty crores. The industry employs a few thousands of hands and has also stimulated a few subsidiary industries[1]. Apart from vanaspati for food, the industry has also produced hardened oil for the soap industry, vegetable tallow and a variety of other products which are finding extensive application. Side by side with these, the industry also produced and is presumably, still producing, a specially hardened product which is in demand for adulterating ghee. Every vanaspati manufacturer may not produce such a product, but there is no doubt that many still continue to do so. It is this last product which led to the earlier prosperity of the industry and subsequently led to a good deal of trouble, disappointment and even diffidence in the future of the industry.

The industry is now awakening to the importance of producing a clean, wholesome product which can stand on its own merits. The Government is also insistent on the marketing of a product which will conform to certain specifications. These will, to a large extent, exercise a check on the use of hardened oil for adulteration. In its own ultimate interests, the industry will also have to exercise strict discipline and discourage the use of vanaspati in any form of adulteration.

STATE DECISION TO EXPAND THE INDUSTRY

Acting on the recommendation of a special Committee and also of the legislature, the Government decided in 1945 to encourage the expansion of the industry to roughly three times its present capacity. A target of 450,000 tons per annum was set up, and it was reckoned that the full expanded capacity will be reached by 1950. The primary reason which led to this decision was the increasing shortage of ghee and its non-availability to the poorer sections of the people. Vanaspati was becoming popular as the poor man's ghee, but there was not enough of that product, though the raw material (crude vegetable oil) was plentifully available. The expansion of the industry was accordingly planned, and the different provinces were allotted their quota of factories. About forty new companies have been floated, and in view of the impending prospects many of them were heavily oversubscribed. Reckoning at an average of about ten lakhs of rupees for each new concern, the capital involved in the new flotations may be estimated at about four crores of rupees. Substantial orders for equipment and accessories have been placed in Europe and elsewhere, and it is expected that some of the new factories will be created and begin production in 1948, if not earlier.

It is not unreasonable to expect that the tripling of the production in such a short period as three years (from 1947) will lead to some temporary glut on the market. Even if the production and distribution are regionalised, there is a fair prospect of the public demanding certain brands of products which have already established their name in preference to others. The preparation of a fully acceptable product is not altogether simple, and some, at any rate, of the new companies will have a certain amount of difficulty in standardising and successfully marketing their products. Although monopoly in industry is unhealthy, the experience gained by the already established firms would have proved very valuable in expanding the industry at a rate in keeping with the actual rise in demand.

THE RECENT CHANGE IN OUTLOOK

About the time that the Interim Government came into office in 1946, apprehension was expressed in several quarters about the possible consequences of the fairly large expansion of the industry. There was also a good deal of objection to the use of vanaspati, in any form, as an article of food. The ghee manufacturers also protested against the proposed increase in the production of vanaspati as that would militate against the interests of their industry. Butter and ghee represent two of the most

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important products of the dairy industry in India, and it was naturally argued that large supplies of vanaspati would reduce the demand for ghee or otherwise lower the market value of the latter. Added to this, the more recent observations reported by Ray and Pal[2] regarding the prolonged effect of feeding vanaspati as the main source of fat to successive generations of experimental animals led to further misgivings about the use of vanaspati as an article of human food. Other laboratories in India did not report similar effects; but their conditions of experimenting were not quite the same: nor were the observations made over such long periods as that reported from Izatnagar. The Izatnagar observations were also apparently at variance with those reported by scientific workers in other parts of the world[3-5]; but they had nevertheless been made by experienced workers of standing whose opinion is entitled to respect. It is possible that there may have been some peculiar features about their experimental conditions or about the products they had compared; but their work revealed the need for a careful examination of the position with special reference to the conditions prevalent in India. This naturally led to a good deal of uneasiness in the minds of the consuming public. The Government was also greatly perplexed. While on one side, they stood committed to expanding the industry, they were led to doubt whether even the existing industry was justified. They were nevertheless very cautious and in his address to the Food Technical Panel on 26th November 1946 Dr. Rajendra Prasad, the Member for Food and Agriculture, stated that though he felt very uneasy about the position, he was nevertheless prepared to await the conclusive and concerted opinion of scientists in regard to the subject. Acting on his advice, a Committee composed of representatives of the different laboratories interested in food and nutrition problems was appointed to go fully into the question and to conduct such fresh research as may be needed prior to making its final report to the Government.

The Present State of Our Knowledge Regarding the Nutritive Value of Margarine and Vanaspati

There is extensive literature regarding the relative nutritive values of margarine and butter. It is now generally accepted that high-melting fats (m.p. 45° C. or more) are rather difficult to digest, though, even recently evidence has been obtained to show that fats with melting points up to 50° C. are digested to nearly the same extent as those with lower melting points.[6-9] Even starting with fats of the same melting point, butter-fat would appear to be superior to the vegetable product[10-12] though in actual practice, the difference is not much seen when the diet is otherwise quite adequate. Theoretically, a similar observation should apply to vanaspati of melting point which is of the same order as that of ghee. Quantitative data with vanaspati of m.p. 37° C. are not yet available, but the earlier products on the Indian market which were of higher m.p. have not produced the same response as ghee even when moderate supplements of vitamins are provided. These observations require to be confirmed.

Ghee prepared out of good dairy butter may be regarded as an ideal form of fat. While that may be maintained as the standard, comparison of vanaspati should also be made with vegetable oils to determine whether the process of hydrogenation and the materials employed therein have produced any marked difference in regard to the food value of the oil and the utilisation of the other food constituents. In this direction also, some literature is available.[13] When the diet is adequate, there does not seem to be much difference between oil and vanaspati.[14] A good brand of vanaspati contains less than 0·5 p.p.m. of nickel* which is non-injurious. The iso-oleic acids formed during hydrogenation do not appear to have any pronounced effect,[15] though, here again, more scientific evidence is needed. The nature and proportion of iso-oleic acids can vary, depending on the procedure followed.

Most of the earlier studies have been with experimental animals receiving adequate diets. Such diets are not normally consumed even in the most prosperous countries which are also comparatively free from religious and sentimental restrictions in regard to the choice of diet. In India where the great majority of people consume a predominantly cereal diet which is also deficient in regard to various food accessories the position in regard to fats would require careful investigation. This would be particularly true of the poor rice diet of South India which is highly lacking in proteins, minerals and vitamins. The evidence already obtained would suggest that with such a diet, there would be poor response even to butter-fat.[16]

Programme of Vanaspati Research

The above facts were fully appreciated by the Special Research Committee appointed by the Technical Panel to go into the question. The Committee which met on 28th January 1947 decided that, before pronouncing any opinion about the nutritive value of vanaspati, there should be an extensive series of comparative studies both with experimental animals and with human subjects. The animal experiments, as now planned, are probably the most elaborate ones yet carried out on the subject. The following five products, fed at 5 per cent. level, will be compared:—(*i*) ghee as prepared out of dairy butter; (*ii*) crude groundnut oil; (*iii*) refined groundnut oil as prepared out of (*ii*); (*iv*) vanaspati of m.p. 37° C. as prepared out of (*iii*): (*v*) vanaspati of m.p. 41° C. as prepared out of (*iii*). The basal diets would be the following:—(*i*) synthetic diet adequate in regard to protein, minerals and vitamins; (*ii*) poor rice diet as used in South India and adopted in a number of earlier researches;[17] (*iii*) poor rice diet plus extra vitamins; (*iv*) poor rice diet plus extra protein

* In some of the preparations on the market nickel upto 10 p.p.m. or more is encountered. This is due to faulty neutralization. As nickel in more than minimum quantities imparts a bad taste and hastens rancidity, there should be rigorous control over the permissible quantity. The permissible limit should be fixed by the Government.

as casein; and (*v*) poor rice diet plus calcium. Apart from growth measurements there will also be metabolism studies following the extent of utilisation of fat, protein and minerals in the different cases. The reserve of vitamin A in livers will also be followed on completion of each series. Representative animals of each group would be bred and the offsprings, after weaning, placed on similar diets for a further series. In this manner, the experiments would be continued for three generations. As now programmed, the animal experiments following the same details will be carried out in four laboratories— the University College of Science, Calcutta, the Indian Dairy Research Institute, Bangalore, the Indian Veterinary Research Institute, Izatnagar and the Indian Institute of Science, Bangalore. The results obtained by all the laboratories will be pooled together before drawing any final conclusion.

The Committee was conscious of the difficulties in maintaining experimental animals on a poor rice diet. The difficulties in breeding animals reared on such a diet was also realised. Albino rats do even more poorly than human subjects on the South Indian rice diet. This is an aspect which requires careful investigation. There are of course some features which differentiate the experimental diet from the diet as actually consumed in South Indian homes. They may be more important as factors in nutrition than has hitherto been realised.

The human metabolism experiments which would be detailed studies bearing not only on the utilisation of the different preparations, but also the attendant protein and mineral metabolism would also be followed. As in the case of the animal experiments, the poor South Indian rice diet would form the basal diet for these studies. The experiments, as now planned, are being carried out at Coonoor, Bangalore and Calcutta. The third series of studies would consist of institution feeding experiments at Bombay, Delhi and Mysore. For these studies, children under fifteen from institutions receiving a predominantly poor cereal diet have been selected.

In this case the comparison will be only between the crude oil and vanaspati of m.p. 37°C. and the object primarily to determine whether any characteristic effect which is not observed in the case of oil is noticeable in the case of vanaspati. Here again, the oil or vanaspati will form five per cent. of the total solid matter in the diet. The children, who will number a few hundreds at each centre will be under experiment and systematic health observation for at least six months. Where facilities exist, metabolism studies will also be carried out.

It is difficult to forecast whether even an elaborate study such as represented by the above programme will give a conclusive answer in a short time. The animal experiments will cover the best part of two years. The human feeding trials may have to be prolonged, and some may even require repetition at other levels. There will, nevertheless, be a useful amount of evidence which would be a pointer for such further work as may be needed.

The programme of research, as now planned, will, among other things, help to throw some fresh light on the fat metabolism of people who are on a predominantly vegetarian diet composed mostly of cereals or millets. The fat requirement of people on such a diet seems to be considerably less than has hitherto been assumed. The work will also throw further light on the nature of factors assisting in the utilisation of fat in the human body.

The Outlook for the Future

One might well ask as to what should be the State policy in regard to the vanaspati industry till some conclusive evidence is obtained. In addition to the older factories, the new ones will also be soon coming into production. What should be done with all the output? This will be a very difficult question to answer. The industry should not be paralysed and, at the same time, the interests of the public should be safeguarded. Acting on proper technical advice, the Government has already legislated that the melting point of vanaspati should be less than 37° C. This would be lower than that of buffalo ghee obtained in some parts of the country, particularly during certain seasons. It has also been legislated that all brands of vanaspati should contain 5 per cent. sesamum oil so as to permit of easy detection when used for adulteration of ghee; that the product should not be labelled or advertised as vegetable ghee and that ghee vendors should not sell it. These are desirable controls, and the industry has also accepted them. *Any further reform or control could be introduced only on the basis of fresh scientific evidence.*

The State and the industry will have to face the problem of an immediate glut on the market when the new factories come into production. Even at the present level of production, there seems to be no shortage of vanaspati. A consumer can purchase any desired quantity without much hardship though here and there, temporary shortage may be noticed. The present position would suggest that vanaspati is chiefly consumed by a section of the community whose number is not large and which is not increasing at a fast rate. It would be very useful if, side by side with the scientific study, some statistics could also be collected regarding the class of users of vanaspati and their approximate consumption *per capita*. Such information will not be difficult to obtain, and, when obtained, it would be very helpful both to the Government and the industry.

In the event of there being a marketable surplus from the expanded industry, there should be plans for the best utilisation of the product. Solid fats have a variety of applications, and it should be the joint effort of both science and industry to find the best possible uses for the products. From this point of view, the decision of the industry to institute Research Fellowships and to establish a Faculty for oil-seeds, oils and fats should be welcomed. It would be useful to consider the hydrogenation of not only edible oils, but also non-edible ones. The latter do not seem to have been well exploited.

The scientific evidence now collected by the different laboratories would only help to show whether refining and hydrogenation carried to a certain point have any pronounced effect on the nutritive value of the vegetable oil. Even

if no serious difference is observed, the product would still not be equivalent to pure ghee. As in the case of margarine, vanaspati should be fortified with vitamin (or provitamin) A and also with vitamin D if it is to become a 'poor man's ghee'. It may also require supplementing with additional glycerides of special value in nutrition.[18-20] The desirability of using mixtures of different vegetable oils instead of a single cheap oil, as is now generally the case, may also require consideration. Improvements should be steadily made both on the initiative of the industry, and, where necessary, also by State legislation. Scientific research along these lines should be continued.

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ABNORMALLY HEAVY RAINFALL IN INDIA — TEMPERATURE INVERSIONS IN TROPICAL AIR MASSES

S. L. MALURKAR

(*Poona* 5)

THE frequency of heavy rain in 24 hours, in the course of nearly 30 years have been published.[1] Occasions when more than 10″ of rain fell in 24 hours have also been recorded.[2,3] The data are based on observations taken at nearly 3,000 provincial rain-gauge stations distributed over India. It is of interest even to attempt a tentative explanation of such rainfalls and their distribution. An analysis of 10″ or more in 24 hours, recorded over such a long period is hardly likely to lead to an easy solution, and becomes theoretically unwieldy. It is possible, however, to raise the limit of rain above which one has to consider. The places recording 15″ or more in 24 hours were noted on a large map of India (scale 1″ = 32 miles). The distribution of places where these abnormal amounts fell has a definite scatter leaving out of account some individual stations. The scatter could be broadly grouped under (*a*) East Gujarat near about the Gulf of Cambay, (*b*) South Assam near the Cachar Valley, to a lesser extent, (*c*) near the Circars and Coromandel Coasts, and finally, (*d*) the individual stations. It looked obvious that data in regions (*a*) and (*b*) would help, by analogy, to explain the instances under (*c*) and (*d*).

As the data refer to an extended series of years over fairly well-distributed rain gauge stations, the conclusions drawn from them *would be generally valid*.

East Gujarat is well north of the Western Ghats. The places that have had a record of heavy rain near the Ghats are Igatpuri (about 80 miles E.N.E. of Bombay) and Malcolmpeth (Satara District.). Some of the rainiest places in Mysore hardly touch 10″ in 24 hours. The average height of the Western Ghats decreases northwards. The rain, therefore, cannot be explained merely by Orography. Similarly, in N.E. India and Burma, one would have expected that the higher level stations along the Arakan Yomas, which are in the path of the monsoon winds, would show instances of very heavy rain as in South Assam. Kanpetlet (Lat. 21° 10′ N., Long. 93° 59′ E.; ht. 6,322 ft.) though considerably higher than Cherapunji (4,309 ft.) has not recorded even as heavy a rainfall.

The heavy rains at Cherapunji mostly occur when the monsoon over North India, *i.e.*, west of Cherapunji, is relatively weak.

Abnormally heavy rain occurs in and near East Gujarat associated with a depression to the east of the place. It is commonly observed that abnormally heavy rain occurs when a depression is almost filling up. When abnormally heavy rain fell in East Gujarat and S.E. Rajputana, the monsoon depression which had caused the abnormal rain did not travel much further west,[4] *i.e.*, the monsoon to the west of Gujarat and S.E. Rajputana would be weak. This shows the analogy in the case of South Assam.

For the formation of a tropical depression in the monsoon and non-monsoon months it is necessary to have three air masses:[5] (*a*) Em—Equatorial Maritime air which come from the other side of the equator—it can be made easily unstable and gives rise to thunderstorms; (*b*) Tr—a mixed Transitional air whose ultimate origins are the high pressure areas of the North Pacific and the North Asiatic continents. It flows along the displaced "N.E. Trades". Though this air is hot and moist and becomes more so in its travel in the S.W. monsoon due to its equator-ward motion, it gains in stability along its path (except perhaps when very near the equator and when about to cross to the other side); and (*c*) Tc—Tropical Continental air, a dry hot air.

A tropical depression fills up or recurves to a northeasterly direction when the supply of Em is cut off[6] and behaves like an extra-tropical depression with only two sectors. The extra-tropical disturbances are more or less active as the "N.E. Trades" feed into it or move away from it. The recurved tropical depression is an extreme case of the "N.E. Trades" feeding into an extra-tropical depression.[7]

As the supply of Em is cut off, when a depression is filling up, the abnormally heavy rain can only be assigned to Tr. Before the recurvature of the tropical depression, Tr has a slightly equator-ward motion and is gaining in stability at lower levels. Its moisture content and temperature are also increasing in the lower levels. As a result of this, a temperature inversion is set up in it which magnifies the stable nature of the air (*infra*). When the depression recurves, Tr becomes the moist and warm sector, and has a pole-ward movement. The hot moist stream which was gaining in stability (as shown by isothermal layers and temperature inversions) now develops latitudinal convergence and gets to be less stable in its N. or N.E. motion, the isothermal layers and temperature inversions get destroyed. The previous temperature inversion has helped in storing large energy. The effect of convergence or divergence with change in latitude is more marked nearer the equator than elsewhere. At the stage of recurvature of a tropical depression, a sort of front, extending from S.W. to N.E. with heavy rain along it develops in the depression.[8] The degree of abruptness with which Tr which till then had an equator-ward motion is *bent back* to a pole-ward direction determines the heaviness of the rain or to put it in other words, the change from stabilising to unstable conditions in the Tr is responsible for the heavy rain. The season and locality are necessary as the properties of Tr depend on them, *i.e.*, the amount of moisture and temperature the air has acquired before getting a pole-ward motion.[9]

The recurvature occurs due to a western disturbance moving in a more northerly latitude, and the rear of the latter provides the fresh Tc to the recurved depression and gives more contrast with Tr than before recurvature. The partition between Tc and Tr gets to be more marked.

During the S.W. monsoon months, the depressions form at the head of the Bay of Bengal and near Kathiawar.[10] The approximate positions of Tr should be to the N.E. of the places.[11] The Tc for depressions about Kathiawar would be from West Asia and adjoining regions of India. Tc for the depressions that form near the Gulf of Siam and Upper Burma would be from Upper India. The heavy rain in South Assam should, therefore, be due to the depressions that recurved over Siam and Upper Burma, and the mechanism should be similar to that which occurs in East Gujarat, *i.e.*, the bending back of Tr with the recurvature of a monsoon depression to the east of the place.

The above explains why a monsoon depression which remains stationary in the west United Provinces gives rise to heavy rain.[12] Under the influence of a western disturbance travelling far north and cutting off of fresh supply of Em, the Tr of the depression is given a northerly bend giving rise to heavy rain.

The heavy rain that falls along the Circars coast is due to the depressions from the Bay of Bengal. The depressions may themselves recurve and produce very heavy rain as in the first few days of June 1941. Due to distribution of land and sea, the other alternative would be the refraction of the trajectories of Tr to the north which would again be conducive to the production of heavy rain. It is well known that heavy rain falls very near the coast just about the time a depression moving in some westerly direction crosses the coast. After crossing the coast, if the depression tends to fill up, there is again a downpour of rain.

The question of *bending back of Tr towards the north coupled with a fresh supply of Tc giving rise to heavy rain* has been verified in a number of particular instances, and is being followed up. The abnormal amounts of rain that were recorded at Bombay on 10th September 1930 (22″) and on 9th September 1946 (9″) seem to have the same cause. In both cases a depression which was to the east of the place filled up about the same epoch.

The bending back of Tr shows as the wedges in the case of the western disturbances in winter and have been stressed elsewhere.[13] The weather only occurs, apart from orography, only where the air is ascending up the latitude.

The problem of heavy rain and its location is reduced to the following of the recurvature or filling up of a depression or the tracing of Tr carefully.

Temperature Inversions in Tropical Air Masses.—As rainfall is intimately connected with convection, a digression on this subject is called for. When an air stream is moving towards the north or south pole, there is latitudinal convergence or there is a tendency for upward convection in the air mass which is calculable. The upward convection would be indicated by a high lapse rate and an absence of a temperature inversion. When, however, the air has an equator-ward motion there is latitudinal divergence and the tendency is for the air to descend. The air stream is gaining in stability and is having slow subsidence (rapid subsidence cannot extend over a long period or area). The lapse rate tends to be below the adiabatic one. The stability of an air mass is, in fact, determined by its capacity to stop convection. This stability increases as the lapse rate decreases from the usual dry or wet adiabatic values. The lapse rate can become zero, *i.e.*, lead to isothermal layers or even become negative leading to temperature inversions. It follows that an equator-bound air stream would exhibit isothermal layers and even temperature inversions.

If the equator-ward moving air stream is passing over a large stretch of water or swampy land, due to its increasing temperature along its path, it would absorb moisture. As the amount of convection is small due to the small lapse rate, the moisture would be confined to lower levels of the stream: below the isothermal or inversion layer. Due to differential effect of radiation, the moisture in the lower levels would give rise to an inversion or sharpen it if one already existed.[14] The picking up of more moisture and temperature in the lower levels and the sharpening of the inversion level due to radiation and due to descent in the latitudes would be the character of an equator-ward moving stream near sea or swampy land. This may be expected to hold good unless the stream is very near the equator and about to cross it to the other side.

Among the equator-ward moving tropical streams Tr is an important one. In the Pacific Ocean and in S.E. Asia it is moving over water or swampy land. Deppermann[15] has given the inversion in the "N.E. Trades" at 1·5 to 2·0 kms. The inversion that occurs over Bengal in the premonsoon months when the "N.E. Trades" have been displaced northwards to that latitude is given a simple explanation. Due to the frequency of monsoon depressions, the thermal structure over Bengal is disturbed, and the inversion is practically wiped out except during long 'breaks' in the monsoon. It is to be made clear that the wiping out is not solely due to the pole-ward moving Em or fresh monsoon air. The only thing this fresh air would do is to allow a parcel of it to pass through the inversion layer. But due to the cyclonic circulation, Tr, which is from the east and had an inversion, gets a slight northerly bend with a tendency to converge, and hence with a tendency for the wiping out of inversion. It is not possible to dynamically figure out the formation of inversions and their wiping out by advection of one or more air masses.[16,17] in the tropics without bringing in the latitudinal changes and radiation.

The inversions at Karachi are due to Tc flowing slightly equator-ward over the Persian Gulf and the North Arabian Sea during the monsoon months. Over lower Sind, the paucity of depressions and less chance of latitudinal convergence make the inversions more persistent about the height of 1·0 km. The deepening of the inversion layer as one moves from Mekran to Kutch also becomes understandable.

A reference to the radio-sonde observations of Addu-Attol, in the old Indian Daily Weather Reports, often shows isothermal layers, and, occasionally, temperature inversions during the northern summer. When the air is about to cross the equator, there is hardly any inversion.

The formation of a temperature inversion is very important as it allows sufficient moisture to accumulate without its being dissipated by convection or immediate thunderstorms. It conserves the moisture and the energy for later release if needed.[18] The inversion in Tr south of the equator, explains the shallow depth of the S.W. monsoon in the neighbourhood of the equator. The diurnal variation of temperature at Nuwara Eliya is nearly 12° F. even on a good monsoon day, showing that the hill station is not well within the monsoon stream. At Mahabaleswar the diurnal variation of temperature is sometimes as low as 2° F. The Mannar and Trichinopoly upper winds also show such variations. The depth of the S.W. monsoon increases with gain in latitude, partly due to sea travel and partly due to latitudinal convergence. Similarly the shallow layer of moisture of the N.E. monsoon in northern winter is explained by the Tr north of the equator having an inversion at about 1·5 kms. This air crosses to the southern hemisphere at intervals to feed the monsoon there. The radio-sonde and aeroplane ascents and the extreme dryness at the high hill stations in South India all show the existence of temperature inversions in the "N.E. Trades" in northern winter.

The data are being further studied.

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THE CENTENARY CELEBRATION OF THE CHEMICAL SOCIETY, LONDON, AND THE ELEVENTH INTERNATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY*

THE Centenary of the Chemical Society, London, at which nearly 1,500 chemists were present, was celebrated in the Central Hall, Westminster, on Tuesday, July 15th; Prof. C. N. Hinshelwood, President of the Chemical Society, presided. Eminent chemists representing the Science Institutions of twenty-eight countries, including France, U.S.S.R., America, Switzerland, Sweden and India, participated in the celebrations. Dr. S. Krishna of Dehra Dun represented India on the occasion. The opening was preceded by a reception at which the distinguished visitors and delegates were received by the President and the Council. Prof. Raymond Delaby, President of the Chemical Society of France, read on behalf of all the delegates from overseas, a message of congratulations to the Society on the achievement of its Hundredth Anniversary. Representatives of Societies from overseas then presented their written addresses of congratulations. This was followed by greetings by Sir Robert Robinson, President of the Royal Society, London, on behalf of the sister Societies in the United Kingdom.

To mark the event, an Exhibition was opened on July 14th at the Science Museum by Prof. Hinshelwood; Mr. George Tomlinson, Minister of Education, presided. Mr. Tomlinson described the gathering as an expression of international friendship and co-operation at its best. The Exhibition is in three sections—Historical—a display illustrating Chemistry in every-day life, and a section of Books on Chemistry. The Historical Section, arranged by the Chemical Society, is concerned with the achievements of British Chemistry during

* A summary report by Dr. S. Krishna who represented India on the two occasions.

the past century, and includes among its exhibits many historic pieces of apparatus. The range is from Faraday's experiments on liquefaction of gases to Sir Alexander Fleming's discovery of Penicillin. Between these extremes lie such things as Perkin's discovery in 1856 of the dye 'Mauve', and Bragg's work on crystal analysis. In the section on Chemistry in every-day life, which has been organized by the Department of Scientific and Industrial Research, an interesting sequence of exhibits shows how chemistry is to-day affecting all aspects of domestic life. It includes sections dealing with such themes as textiles, buildings, roads and transport, fuel, power, health, and food. The exhibition constitutes one of the most comprehensive displays in the history of science yet seen in the United Kingdom.

Before an audience described as the "most representative and distinguished gathering of chemists ever seen in London", Sir Robert Robinson delivered the Faraday Lecture on "the Development of Electro-Chemical Theories of the Course of Reactions of Carbon Compounds", and received the Faraday Medal—the highest honour that can be bestowed by the Chemical Society. The lecture was preceded by a dignified ceremony at which Prof. N. J. Bjerrum (Denmark), Prof. J. N. Bronsted (Copenhagen), Sir Henry Dale (Britain), Prof. George C. Hevesy (Stockholm), Prof. P. Karrer (Zurich), Prof. L. C. Pauling (U.S.A.) and Prof. Ruzika (Zurich) were formally admitted to the Society as Honorary Fellows. The most impressive of all the ceremonies was the Graduation ceremony at which the London University conferred Honorary degrees of Doctor of Science (*honoris causa*) on Professors Bronsted, Hinshelwood, Karrer and Pauling. This was followed by a dinner by the Duke of Athlone, the Chancellor of the University.

The Prime Minister attended the Centenary Dinner of the Chemical Society, at the Dorchester Hotel on 15th July. He said that "the party to which he belonged had for many years been anxious to make changes in the organization of the Society, but the changes it was carrying out were insignificant compared with those brought about by the Chemist". As a politician, the moral he drew was that the Government must keep close touch with the Chemist. Mr. Attlee concluded his speech by saying that "Science, like music and art, was international. It should be one of the things which bound the peoples of the world together, not something which separated them". Responding to the toast, Prof. Hinshelwood said that "Chemistry, like all sciences, was a tree of good and evil. The powers that it conferred were mighty, and they could be terrible. The control of them was a matter for the general conscience of mankind". Further on he described "as a welcome sign in the past few years the increasing number of scientific papers published from the chemical industry: clear evidence that leaders of that industry were showing understanding of the intellectual needs of the men who served it". "One can only hope, he added, "that the whips of commercial secrecy will not be succeeded by the scorpions of military security." At a luncheon given by His Majesty's Government, Mr. Herbert Morrison, Lord President of the Council, said that "Young chemists should pursue fundamental research, but the modern world required that the time-lag between scientific discovery and application must be short."

During the celebrations which lasted three days (15th to 17th July) visits were arranged to the British Drug Houses; the Distillers Company Ltd., Epsom; Kodak Ltd., Harrow; the Research Institute, Beckenham; Chemical Research Laboratory, Teddington; and the Fuel Research Station, East Greenwich.

Receptions were held by the Imperial Chemical Industries, the Royal Society, and the Royal Institution.

The Centenary Celebrations were followed by the Eleventh International Congress of Pure and Applied Chemistry which opened at the Central Hall, Westminster, on 17th July. Lord Leverhulme, addressing 2,000 delegates from all over the world, said that the Congress was a "significant act of international co-operation. A better understanding of the world might well be promoted by a gathering like that which had brought together men and women from nearly thirty countries, all united in one common purpose—the progress of the science of Chemistry". Nearly 400 papers were presented, but a significant omission was that of any direct reference to nuclear energy. This was explained by Sir Wallace Akers, who was Director of Research in Atomic Energy during the war, to the press, saying that "the Government that had knowledge of these particular developments had decided to impose an embargo on that Knowledge until some other arrangement was made. It is well known to chemists engaged in atomic energy research that their information was only a fraction of what was known, and it was impossible for an honest person to present to the Conference anything that purported to make a serious contribution to the chemical aspect of the development."

Conferences of fourteen sections of the Congress were held simultaneously in separate rooms at the Imperial College of Science and Technology, South Kensington. The sections were the following with the names of their Presidents in brackets:—(1) Inorganic and Geo-Chemistry (Prof. H. V. A. Briscoe), (2) Physical Chemistry (Prof. S. Sugden), (3) Organic Chemistry (Prof. A. R. Todd), (4) Bio-chemistry (Prof. A. C. Chibnal), (5) Chemistry in relation to Agriculture and Applied Botany (Prof. T. Wallace), (6) Chemistry in relation to Applied Zoology and Veterinary Sciences (Dr. W. R. Wooldridge), (7) Chemistry in relation to Food and Nutrition (Sir Jack Drummond), (8) Chemistry in relation to Medicine and Therapeutics (Dr. C. H. Harington), (9) Chemistry in relation to Fuel, Power and Transport (Sir Alfred Egerton), (10) Chemistry in relation to Natural and Artificial Textiles (Sir Robert Pickard), (11) Chemistry in relation to Elastomers, Plastics, Glass, and Ceramics (Prof. H. Moore), (12) Chemistry in relation to Metals (Mr. S. Robson), (13) Chemical Engineering (Dr. A. J. V. Underwood), (14) Chemistry in relation to Essential Oils, Flavouring Materials and Cosmetics (Mr. R. K. Allen).

The discussion covered a wide field. For example, in the Nutrition Section addresses

were delivered on the experiences of groups of men who were deprived of adequate diets in occupied territories, prisoners-of-war camps and elsewhere during the war. The chemistry of underground gasification of fuel was discussed by Dr. Demart of Belgium. The paper on the control of tsetse fly was of interest from the point of view of development of food production in Africa. The raw materials of rayon manufacture were discussed by Dr. Levenstein, and the production, properties and uses of seaweed rayon by Prof. Speakman.

Apart from the sectional meetings, there were several Congress lectures. These were delivered by: (1) Prof. L. Pauling (U.S.A.), on the nature of bonds in metals and intermetallic compounds; (2) Sir Henry Dale (U.K.), on the part of chemistry in the new therapeutics; (3) Prof. P. Karrer (Switzerland), on some recent advances in organic chemistry; (4) Prof. A. Tisalius (Sweden), on the recent development in electrophoresis; (5) Prof. L. Hackspill (France), on La corbura de calcium et ses propertés reductrices; (6) Sir Howard (U.K.), on some biological properties of chemotherapeutic antibiotics. Sir Robert Robinson delivered the closing address. The next International Congress will be held in 1949 in Holland.

INDIAN STANDARDS INSTITUTION

THE Indian Standards Institution, referred to as ISI (pronounced "Eye-Sigh") for short, which brings India in line with other countries of the world, has been established under the auspices of the Industries Department of the Government of India. The Central Government has undertaken to finance this Institution for the first five years with an annual grant of two lakhs of rupees, which grant is being handsomely supplemented by the various Provincial and State Governments as well as the industry of the country. It is hoped that, in due course, industries will be able to support the Institution without any help from the Government.

There already exist in India certain standardisation organisations such as the Inspection Wing of the Directorate-General of Industries and Supplies, Central Standards Office of the Railway Board, Inspectorate Organisation of the Master-General of Ordnance, Development Organisation (Armaments) of the Defence Department, Bureau of Standards (Medical Institutions), Directorate-General of Indian Medical Service, Indian Drugs Act, Agmark Standards, etc. All these have been initially conceived to meet the requirements of a specific department of the Government who are large-scale purchasers of the industrial output of the country. The functions of the ISI, *vis-a-vis* these organisations will be to co-ordinate the standards of general interest prepared by them and promote them on an all-India basis.

ISI has its headquarters at New Delhi in Jaisalmer House on Mansingh Road. Affairs of the Institution are administered by the General Council, on which are represented departments of the Government of India, Provinces and States, professional societies of engineers and scientists, Chambers of Commerce, industries and other important interests. The Director is responsible for the conduct and activities of the Institution. The technical work for the preparation of standards is to be dealt with through various technical committees appointed by one of the five Divisional Councils, namely, (*a*) Engineering, (*b*) Buildings, (*c*) Textiles, (*d*) Chemicals and (*e*) Agricultural and Food Products Division Councils. Of these, it is proposed to organise only two Councils at present, namely, Engineering and Textile Division Councils.

The membership of the Institution is divided into two categories—the Sustaining Members and Ordinary Members. Sustaining membership is open to companies, firms, educational institutions and other corporate bodies, while the ordinary membership is intended for individuals interested in the work of the Institution.

The producers as well as the large-scale consumers such as the Government Departments are well organised and can readily voice their opinions in the shaping of standards. It may be stated that with the establishment of popular governments at the Centre and elsewhere, the Government representatives on the various bodies of the Institution may be relied upon to keep in mind the interests of the masses. Eventually it may become possible to develop in the country such consumers' organisations as exist in the United States of America, United Kindom and elsewhere.

It is the intention of the ISI to introduce what will be known as Standards Mark or Marks. The privilege for the use of these Standards Marks in conjunction with goods offered for sale will be granted to only such producers who give satisfactory evidence of their ability to exercise strict quality control on production and provide laboratory and inspection facilities necessary for ensuring that the goods they produce conform to the relevant Indian Standards.

It must also be realised that the opinion of both the consumers and producers must be backed by scientific tests and carefully planned investigations, and this is where the newly formed National Laboratories organised by the Council of Scientific and Industrial Research will assist. Besides these Laboratories, all other specialised scientific institutions in the country will be called upon to lend facilities for the development of standards relating to their own field of speciality.

The task of standardisation on an international basis will be dealt with by the recently formed International Organisation for Standardisation, ISO (pronounced "Eye-So") with its headquarters at Geneva, Switzerland. The Indian Standards Institution is a member of the ISO and represents India in all matters of standardisation. It should be a matter of great satisfaction to us all that India has been elected to the Governing Council of the ISO for the next three years. India, through ISI, will also act as the Secretariat for the preparation of international standards for Lac and Mica.

Dr. Lal C. Verman, Assistant Director of the Physical Laboratories of the C.S.I.R., has been appointed Director of the Indian Standards Institution.

LETTERS TO THE EDITOR

ON SPHERICALLY SYMMETRICAL SOLUTIONS IN RELATIVITY

Narlikar[1] has recently reported as new some results regarding spherically symmetrical fields in Relativity. May I say that several solutions for the line-element representing such fields were found out by me[2] in 1939? All such solutions are implicit in the single differential equation arising out of the physical condition of isotropy,[3] *viz.*,

$$T_1^1 = T_2^2 = T_3^3 = -p \tag{1}$$

in the usual notation. My solutions are similar to those of Narlikar. I am giving below a correspondence between the results given by Narlikar and those obtained by me in 1939 while discussing a cognate problem. For such problems it is customary to start with the following line-element,

$$ds^2 = e^{\nu}\,dt^2 - e^{\mu}\,(dr^2 + r^2 d\theta^2 + r^2 \sin^2\theta\, d\phi^2), \tag{2}$$

where $\mu = \mu\,(r, t)$, $\nu = \nu\,(r, t)$. The physical condition of isotropy then yields the second order non-linear differential equation, *viz.*,

$$(\mu'' + \nu'') + \tfrac{1}{2}(\nu'^2 - \mu'^2) - \frac{1}{r}(\mu' + \nu') - \mu'\nu' = 0, \tag{3}$$

where a dash denotes a differentiation with regard to r.

Of the three cases discussed by me in the paper cited above, the first two correspond to Narlikar's $\beta(r)$ being equal to zero. They are represented respectively by the differential equations,[2]

$$\left.\begin{aligned} &\mu'' - \tfrac{1}{2}\mu'^2 - \frac{1}{r}\mu' = 0, \\ &2\mu_{11} - \mu_1^2 = 0 \end{aligned}\right\} \tag{4}$$

where in the latter differential equation the suffix "1" means a differentiation with regard to χ, $\chi = t^2 - r^2$. These results were, however, obtained directly from (3) on the assumptions $\nu = 0$, $\mu = \mu\,(r, t)$ for the first case and $\mu = \nu =$ constant for the second. The third case is more general, the main assumption for it being that μ and ν can be expressed as a sum and difference respectively of functions of r only and functions of t only, that is, $\mu + \nu = f\,(r)$ with $\theta\,(r)\,\psi\,(r) =$ constant. It is not, however, necessary to go into any further details in this connection.

Secondly, although Narlikar has stated that equation (1) of his letter is an integral, it is not known of what differential equation it is an integral. I may, therefore, be allowed to state explicitly that his equation (1) giving $\beta(r)$ is the first integral of the differential equation arising out of the physical condition of isotropy. I give below its necessary derivation. The only surviving components of the energy tender are

$$\left.\begin{aligned} &T_1^1 = T_2^2 = T_3^3 = -p,\ T_0^0 = \rho, \\ \text{and}\qquad &T_1^0 = -\frac{e^{-\nu}}{8\pi}\,(\dot{\mu}' - \tfrac{1}{2}\dot{\mu}\,\nu') \end{aligned}\right\} \tag{5}$$

where a dot denotes a differentiation with respect to t. By virtue of the physical condition of isotropy $T_1{}^0 = 0$, that is,

$$\dot{\mu}' - \tfrac{1}{2}\dot{\mu}\,\nu' = 0,$$

which gives on integration

$$\left.\begin{aligned} &\dot{\mu}^2 = e^{\nu} f\,(t), \\ \text{or}\qquad &\dot{\mu} = e^{\nu/2} f^{\frac{1}{2}} \end{aligned}\right\} \tag{6}$$

Differentiate (6) with respect to r once or twice as required and substitute for ν in (3). After some reduction we get the differential equation, *viz.*,

$$\frac{\partial}{\partial t}\left[\log\left(\mu'' - \tfrac{1}{2}\mu'^2 - \frac{1}{r}\mu'\right)\right] + \tfrac{1}{2} e^{\nu/2} f^{\frac{1}{2}} = 0,$$

which simplifies to

$$\frac{\partial}{\partial t}\left[e^{\mu/2}\left(\mu'' - \tfrac{1}{2}\mu'^2 - \frac{1}{r}\mu'\right)\right] = 0 \tag{7}$$

This gives on integration

$$e^{\mu/2}\left(\mu'' - \tfrac{1}{2}\mu'^2 - \frac{1}{r}\mu'\right) = \phi\ (r) \tag{8}$$

while the second equation (6) gives

$$\mu = \int e^{\nu/2} f \tfrac{1}{2}\, dt + \psi\ (r) \tag{9}$$

(8) and (9) will together yield a relation of the form,

$$\log \phi\ (r) = \psi'' - \frac{1}{r}\psi'' + \tfrac{1}{2}\int r dr \int \frac{1}{r}\left(\psi'' - \frac{1}{r}\ \psi\right) dr$$

or, $$\log \{\phi\ (r)\} = \psi'' - \frac{1}{r}\psi' + \tfrac{1}{2}\ \psi \tag{10}$$

giving $\phi(r)$ in terms of $\psi\ (r)$ and its derivatives. It will be seen that

$$\phi\ (r) = 2\,\beta\ (r).$$

As regards the other points mentioned by Narlikar in his letter I shall not discuss them here as these will be incorporated in a separate paper to be communicated for publication elsewhere.

Poona, D. N. MOGHE.
May 28, 1947.

1. Narlikar, *Curr. Sci.*, 1947, **16**, 113. 2. Moghe, *Proc. Ind. Acad. Sci.*, 1939, **10**, 407. 3. *Ibid.*, 1939, **10**, 275.

ANOTHER METHOD OF CALCULATING SQUARES OF NUMBERS

IN a previous article[1] I have given a new method of obtaining squares of numbers, large or small, by mental calculation only. With a view to reducing this mental work further, especially when a majority of figures in the given number are greater than 5, another method is illustrated here.

(1) A number of two digits—88.

$$\begin{array}{l} 88 \\ 12 \\ \hline 144 \\ 76 \\ \hline 7744 \end{array}$$

Subtract the units digit of the original number from 10, and the remaining ones from 9; thus the new number is 12. Square this number, 12, by the method last suggested.[1] It is 144. Double the original number, and enter the first two digits of this product beginning from below the third digit of the last number, as it is necessary to leave out as many digits as there are in the original number. Thus we get 76. Add the numbers together, as in the example, and we get 7744, the required square.

(2) A number of three digits—649.

$$\begin{array}{l} 649 \\ 351 \\ \hline 123201 \\ 298 \\ \hline 421201 \end{array}$$

Subtract the units digit of the original number from 10, and the remaining ones from 9,—351. Square 351—123201. Double the given number, and enter the first three digits of the product beginning from below the fourth digit of the last number as shown in the example—298. Addition gives 421201, the square of 649.

(3) A number of five digits—75684.

$$\begin{array}{l} 75684 \\ 24316 \\ \hline 591267856 \\ 51368 \\ \hline 5728067856 \end{array}$$

Subtract the units digit of the original number from 10 and all the remaining digits from 9—24316. Square this number—591267856, which is written below the line. Double the original number, and write down the entire product, excepting the last digit, in such a way that the units digit of this comes exactly below the sixth digit of the square as shown above. Add together the two numbers between the lines,—5728067856, the required square.

The former method[1] gives the result quicker when the figures in the number are less than 5; whereas by this method the square is obtained more readily with numbers of more than 5 digits.

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April 9, 1947.

1. Siddiqi, *Curr. Sci.*, 1947, **16**, 178.

AN ADDITIONAL RAINBOW

AT 6-10 p.m. on Monday, the 14th July 1947, there was a heavy shower of rain with the sun shining very bright in the west. Thinking that these were the most favourable conditions for the formation of an almost complete rainbow, I went out and saw, as expected, the usual beautiful rainbow, very intense in colour, forming nearly a full semicircle without any gap, accompanied by the secondary and the supernumeraries which were all explained by Airy on the basis of the theory of diffraction by rain drops.

But one surprising feature of this occasion was the appearance of an extra rainbow. Fig. 1 indicates the size and the dispospition of the additional rainbow with respect to the usual one. The former is given in the thick line to differentiate it from the latter. Its general features were:

1. It was not concentric with the normal rainbow, there being a definite inclination between the two as indicated in the figure.
2. Its intensity was nearly equal to that of the usual secondary rainbow.
3. Only a small portion of it could be seen covering the arc of another circle included between the normal primary and secondary as given in the figure.
4. The portion thus seen was to the south, but its counterpart at the other end of the corresponding circle was almost merged with the northern bottom of the normal primary.

5. There was a slight but unconfirmed indication of a relative movement between the new rainbow and the normal.

On account of the displacement of the new one both with respect to its centre and its in-

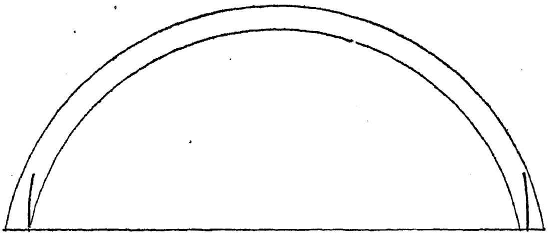

FIG. 1

clination relative to the normal rainbow, it must have its origin in the reflected image of the sun at some surface. Such a surface must be a large sheet of water or the surface of a cloud. But the smallness of the displacement does not warrant the former hypothesis. It appears, therefore, that the source for this extra rainbow must be the reflected image of the sun over a cloud. This surface must be the top one as the new bow forms a larger arc of a circle than the normal as is apparent from the figure. A large sheet of cloud was also present in the west in a suitable position for such a reflection to take place. The smaller intensity of the new bow also confirms this hypothesis as the surface of the cloud can only be a poor reflector.

Further qualitative or quantitative data could not be taken on this phenomena owing to its transient nature.

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July 16, 1947.

THERMODYNAMIC CHARACTERISTICS OF THE EQUILIBRIUM BUTENE –1 ⇌ BUTADIENE –1, 3 + HYDROGEN

THE above equilibrium was studied experimentally in this laboratory by Ghosh and Roy[1] and accurate values for the equilibrium constant K_p were obtained at five temperatures. From the values of the equilibrium constant an equation was derived[2] for the free energy change ΔF_T of the reaction, assuming the *approximate* specific heat equation.

$$\Delta C_p = 6{\cdot}86 - 0{\cdot}0046\ T + 0{\cdot}000{,}0006\ T^2$$

as the specific heat of butadiene was not then known. When two sets of reliable values for the specific heat of butadiene had become known a re-evaluation was made.[3] After a careful study of existing spectroscopic and calorimetric data, Aston *et al.*[4] have given tables for the specific heats of butene and butadiene from which it is found that Beeck's[5] value for butene assumed in the original paper[2] and in the subsequent note[3] is much too low. The specific heat equation for the above equilibrium on the basis of Aston's results is

$$\Delta C_p = 6{\cdot}256 - 0{\cdot}002734\ T - 0{\cdot}00{,}00{,}0246\ T^2$$

and this in conjunction with equilibrium data[1] gives as the standard free energy equation.

$$\Delta F_T = 25{,}612 - 6{\cdot}256\ T\ \ln\ T + 0{\cdot}001367\ T^2 + 0{\cdot}00{,}00{,}00{,}41\ T^3 + 16{\cdot}05\ T$$

and the thermodynamic characteristics at standard state as

$\Delta F^\circ_{298} = 19{,}884$ $\Delta H^\circ_{298} = 27{,}334$ and $\Delta S^\circ_{298} = 25{\cdot}0$

as against the values given in the original paper[2]

$\Delta F^\circ_{298} = 20{,}015$ $\Delta H^\circ_{298} = 27{,}342$ and $\Delta S^\circ_{298} = 24{\cdot}6$.

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July 21, 1947.

1. Ghosh and Roy, *Proc. Nat. Inst. Sci.*, India, 1946, **22**, 97. 2. —, *Ibid.*, 1946, **22**, 115. 3. Ghosh and Rama Das Guha, *Curr. Sci.*, 1946, **15**, 125. 4. Aston, *et al.*, *J. Chem. Phys.*, 1946, **4**, 680. 5. Beeck, *Ibid.*, 1936, **4**, 680.

STUDIES IN ANTIMALARIALS—SOME SULPHA-BIGUANIDE DERIVATIVES

AMONG sulphanilamides[1–3] sulphadiazine is the most effective and possesses a slight but definite prophylactic action[4] in malaria. Metachloridine,[3] a recent suppressive antimalarial drug of the sulpha-group, is also a pyrimidine derivative.

Considering the activity of sulphadiazine, Curd and Rose[5] prepared at first its sulphur-free analogues of phenyl-substituted pyramidine type and their later work culminated in the discovery of paludrine,[5,7] which is a substituted biguanide derivative.

Compounds of the type (I) have not shown appreciable antimalarial activity[6] which might be partly due to lack of any potential substituent in the aromatic nucleus at N^5-position of the biguanide molecule. Hence it was thought of interest to prepare compounds of type (II) where "SO_2NH_2" or substituted "SO_2NH_2" radical is introduced in the aromatic nucleus at N^5-position, and for this purpose only potent sulpha compounds, sulphanilamide, sulphathiazole and sulphadiazine were selected. It may be mentioned that compounds of the type (III) have already been patented[8,9] as therapeutic agents.

$$\underset{}{R{\cdot}C_6H_4{\cdot}\underset{1}{NH}{\cdot}\underset{2}{C}(=NH){\cdot}\underset{3}{NH}{\cdot}\underset{4}{C}(=NH){\cdot}\underset{5}{NH}{\cdot}R'HCl} \quad \text{.. (I)}$$

R = alkyl, halo, nitro. etc. R′ = phenyl or naphthyl

$$p\text{-}R{\cdot}C_6H_4{\cdot}NH{\cdot}C(=NH){\cdot}NH{\cdot}C(=NH){\cdot}NH.{\cdot}C_6H_4{\cdot}SO_2NHX{\cdot}HCl \quad \text{.. (II)}$$

(*a*) X=H and R=H, m.p. 228°; R=Cl, m.p. 233°; R=Br, m.p. 245–6°; R=NO_2, m.p. 217°; R=CH_3, m.p. 231°; R=CH_3O, m.p. 234°.

(*b*) X=2-thiazolyl and R=H, m.p. 225°; R=Cl, m.p. 219°; R=Br, m.p. 197° (with

decomp.); R=NO_2, m.p. 267°; R=CH_3, m.p. 189–190° (with decomp.); R=CH_3O, m.p. 176° (with decomp.).

(c) X=2-pyrimidyl and R=H, m.p. 238°; R=Cl, m.p. 189°; R=Br, m.p. 202°; R=NO_2, m.p. 246°; R=CH_3, m.p. 232° (with decomp.); R=CH_3O, m.p. 210–212° (with decomp.)

$$R\cdot C_6H_4\cdot SO_2NH\cdot C(=NH)\cdot NH\cdot C(=NH)\cdot NHR' \quad \ldots (III)$$

R=NO_2, AcNH, NH_2, etc. R′=H, alkyl or aryl.

The eighteen new compounds indicated above have been synthesised by the interaction of the hydrochloride of the required sulpha-derivative and the corresponding para-substituted-phenyl-cyanoguanidine in boiling aqueous dioxan medium. The compounds were obtained as their hydrochloride salts and crystallised from dilute alcohol or water. The substituted phenyl-cyanoguanidines were obtained after denitrogenating the corresponding substituted phenyl-azocyanoguanidines and the report of a systematic study of the denitrogenation of similar triazines will be communicated later. These compounds which are fairly soluble in water and bitter in taste are being tested against bird malaria (*P. gallanaceum*) for their activity as antimalarials.

Further work on substituted biguanides as possible antimalarials is in progress. Full paper will be published elsewhere.

One of the authors (H. L. Bami) wishes to thank the Indian Research Fund Association for the award of a research fellowship which enabled him to undertake this work.

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July 25, 1947.

1. Diaz de Leon, *Public Health Reports, Washington*, 1937, **52**, 1460. 2. Curd, *Ann. Trop. Med. and Parasitol*, 1943, **37**, 115. 3. Bami, Iyer and Guha, "Recent advances in the chemistry of synthetic antimalarials," *Science and Culture*, 1947, **13**, 18–26. 4. Curd, *Ann. Trop. Med. and Parasitol.*, 1945, **39**, 147. 5. Curd and Rose, *J.C.S.*, 1946, 343. 6. —, *Ibid.*, 720. 7. Bami, Iyer and Guha, *J. Indian Inst. Sci.*, 1946, **29A**, 1-8. *cf. Science and Culture*, 1946, **12**, 448. 8. Rose, B.P., 550538, 1943. 9. Winnek, U.S.P., 2295884, 1943.

RENNET COAGULATION OF VEGETABLE MILKS

The *in vivo* digestibility coefficients of soya and groundnut protein as present in their milks have been shown to be 92 and 95 respectively as compared with 93 of cow milk protein.[1] In contrast with this, even high doses of animal rennet failed to coagulate the vegetable milks. This occurred in spite of raising the low (30 mg./100 c.c. of milk) calcium content of vegetable milks to the level of that of cow milk (120 mg./100 c.c. milk). Addition of soya milk to cow milk progressively retarded coagulation by animal rennet, curdling of cow milk being altogether inhibited above 100 per cent. addition. The corresponding dilution of cow milk with water retarded the rate of coagulation but did not altogether inhibit it. The peculiar property of the vegetable milks is not due to the thermolabile inhibiting factor reported by Tauber,[2] as the preparations used in our experiments were processed products obtained after prolonged boiling.[3]

In contradistinction to the activity of the animal rennet, we find that vegetable rennets from different sources and, particularly the one from the latex of *Ficus carica*,[4] coagulate both animal and vegetable milks with equal facility. This difference in the activities of the two groups of rennetic enzymes is under study.

The mechanism of digestion of vegetable milks in the animal body is still comparatively obscure. Attention[5] has already been drawn to the wide disparity between the *in vitro* and the *in vivo* digestibilities of soya milk. There is increasing volume of literature[6–11] on the nature and properties of the trypsin-inhibitor of soya-beans. We have found that the trypsin inhibitor has no inhibiting action on rennetic activity.

The foregoing observations would show that the digestion of vegetable milks in the animal body follows a different course from that of the animal milk. The ultimate results, as represented by utilisation in the animal body, seem, however, to be the same. Further studies designed to throw fresh light on the mechanism of digestion are in progress.

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August 13, 1947.

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AMMONOLYSIS OF ALIPHATIC KETONES WITH HYDROGENATION

During the course of our studies in the synthesis of compounds allied to paludrine[1,2,3] considerable difficulty was met with in preparing isopropylamine, one of the necessary intermediates. In our early experiments this was prepared by both Gabriel's[4] and Hoffman's[5] methods which were tedious and lengthy.

Direct ammonolysis of acetone with hydrogenation was a feasible approach which was

TABLE I
Preparation of aliphatic amines from Ketones

	Ketone	Corresponding amine	B.P. C°/685 mm.	Yield %
1	Acetone	Isopropylamine $CH_3CH(NH_2)\cdot CH_3$	32–34	91
2	Methyl ethyl ketone	2-Aminobutane $C_2H_5CH(NH_2)\cdot CH_3$	60–62	87
3	Diethyl-ketone	3-Aminopentane $C_2H_5CH(NH_2)\cdot C_2H_5$	84–86	75
4	Methyl-*n*-propylketone	2-Aminopentane $CH_3CH(NH_2)CH_2C_2H_5$	88–89	87
5	Methyl-isobutylketone	β-Isohexylamine $CH_3CH(NH_2)\cdot CH_2\cdot CH(CH_3)_2$	99–102	80
6	Methyl-*n*-amylketone	2-Aminoheptane $CH_3\cdot CH(NH_2)\cdot(CH_2)_4\cdot CH_3$	136–138	46
7	Methyl-*n*-hexylketone	2-Aminooctane $CH_3\cdot CH(NH_2)\cdot(CH_2)_5CH_3$	164–165	60

tried later on with very encouraging results. Acetone was converted into isopropylamine in good yields by using aqueous or alcoholic ammonia in excess with hydrogen under a pressure of 100 lbs./sq. in. and at a temperature of 50–60° C. in presence of Raney's nickel as catalyst (5–10 per cent.).

A number of other aliphatic ketones were used in the synthesis of the corresponding aliphatic amines (Table I). In the case of water-immiscible ketones, solvents, higher temperature and longer period of reaction were necessary. Amines were isolated from the reaction mixture as their hydrochloride salts, regenerated with alkali and purified by repeated distillation. In all the experiments the primary amines were the main products, and only negligible amounts of secondary or tertiary amines were obtained.

The mechanism of the reaction has been explained by Loffler[6] and Magnonic.[7] The present series of experiments indicate that this method is of general applicability for converting aliphatic ketones into corresponding amines. Details of this work will be published elsewhere.

One of the authors (H. L. Bami) wishes to thank the Indian Research Fund Association for the award of a research fellowship which enabled him to undertake this work.

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July 25, 1947.

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PHENOLPHTHALEIN AS ADSORPTION INDICATOR IN ARGENTOMETRIC TITRATIONS

IN a recent communication[1] the applicability of resorcinol-succinein as adsorption indicator has been described. I find that phenolphthalein is adsorbed to an appreciable extent by the AgCl—Ag$^+$ system, and can be used as an adsorption indicator for titrations of chloride ions against silver ions at a pH of 8–10. In this range it gives on adsorption a definite pink colour to the silver chloride particles.

For the practical application of the indicator, a drop of 0·2 per cent. phenolphthalein is added to 10 c.c. of potassium chloride (about N/10) solution. A drop or two of dilute ammonia is now added until the solution assumes a slight pink colour. Silver nitrate is now run in, and as soon as the equivalent amount of silver nitrate has been added, just a drop of the titrating solution in excess causes the coagulation of silver chloride which separates out as a definitely bright pink mass leaving the supernatant solution colourless.

Quantitative measurements on the adsorption of phenolphthalein by the neutral and positively charged silver chloride bodies will be published in detail elsewhere.

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July 15, 1947.

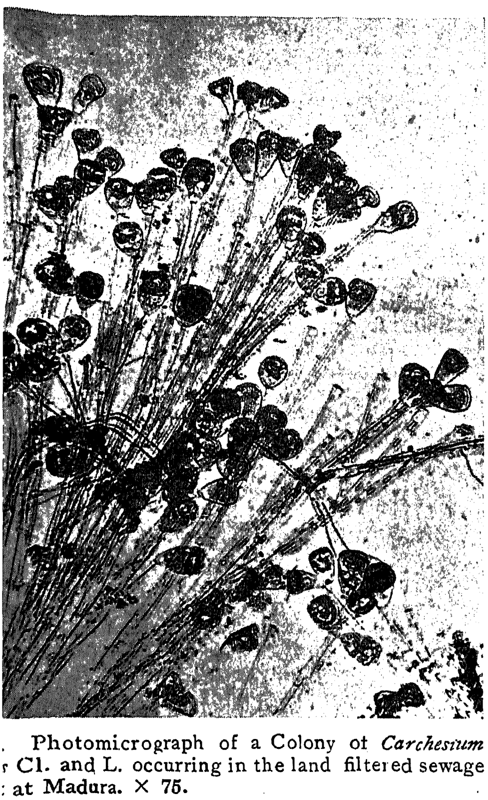
1. *Curr. Sci.*, 1947, **16**, 110.

ON THE OCCURRENCE OF PROTOZOA IN LAND-FILTERED SEWAGE EFFLUENT

IT has been shown that certain ciliate protozoa, particularly Vorticellids, are of special significance in the Activated Sludge Process and other artificial systems of sewage purification, and that these protozoa in the sewage tanks are originally derived from soil.[1-10] Further observations carried out during the last four years at

ra (South India) have shown that these oa naturally develop in large numbers in nd-filtered sewage effluent and from an tant link in the chain of life processes medium. The practice of land-filtration vage and the soil conditions at Madura, iode of development of the protozoa in ffluent and related aspects are briefly bed below.

lura has now a population of about three half lakhs, and the sewage from more ialf the population is discharged into the ipal sewers. The daily discharge of e from this population is about three a gallons, including a comparatively quantity of liquid waste from the textile About two million gallons of this volume



. Photomicrograph of a Colony of *Carchesium* r Cl. and L. occurring in the land filtered sewage : at Madura. × 75.

vage is daily filtered, without any preient, on an area of about 113 acres of sloping land in the neighbourhood of the The soil is fairly porous and the efficiof the soil drainage is maintained by havinderdrains and also by periodically ing the sewage matter accumulating on il surface.[11] The underdrains consist of n pipes loosely jointed and laid in rows lepth of 3 to 4 feet, the distance between ows of pipes being about 33 feet. The of the land-filtered liquid, which is fairly flows down through these pipes into a lly constructed effluent channel. The it from this channel (the quality of the it generally conforms to the Royal Comn Standard) is finally utilised along with irrigation water for agricultural purposes. The land filtering the raw sewage is also cultivated and the principal crop grown is guinea grass which yields very well (about 120 tons per acre per year).

On either side of the effluent channel, as also attached to certain green algæ, may be seen large whitish fluffy masses of Vorticellids which are composed of a number of species of *Carchesium* and a few species of *Epistylis*. The dominating forms are the species of *Carchesium* and one of the commoner species is *Carchesium epistylis* Cl. & L. (Figs. 1 and 2). Species of the simple *Vorticella* and other ciliate protozoa, such as *Paramœcium*, also occur in the effluent. Along with the protozoa, worms, insect larvæ, especially those of

FIG. 2. An individual of *C. epistylis* Cl. and L. enlarged × 350.

Chironomus sp., prawns, crabs, gastropods, frogs, fish and other forms also flourish.[11]

The protozoa and other fauna develop in large numbers in the effluent in all seasons of the year unless sewage irrigation is stopped for unduly long periods, as under the conditions of excessive and continual rains, when they slowly disappear; but when the sewage application is resumed, the fauna also gradually develop. Thus during October-December 1946, when sewage irrigation was stopped due to unusually heavy rains, from 30th October to 20th November and again from 30th November to 19th December, the protozoal growths and other fauna, particularly the fish, were largely absent from the effluent, but reappeared when sewage irrigation was continued.

We have made a similar observation in regard to the development of protozoa in the Activated Sludge tank, *viz.*, if aeration of sewage is continued without any fresh supply of raw sewage, the protozoa cease to multiply and become inactive and eventually disappear, presumably because of the lack of nutrients from raw sewage. In this connection it is of special interest to observe that examination of activated sludge from the purification plant at Bangalore over a period of several years has not revealed the presence of any species of *Carchesium*, while there is always a preponderance of *Carchesium* sp. in the land-filtered sewage effluent at Madura. The significance of this observation is still under study.

The occurrence of *Carchesium lachmanni* in oxidising filters was reported many years ago by Boyce.[12] Fowler[13] observed this protozoan in the effluents from the contact beds and percolating filters at Davyhulme, Withington and Gorton Sewage Works (Manchester). Recently Lloyd[14] has drawn attention to the more important ciliate protozoa occurring in percolating filters and these forms include *Carchesium*, *Vorticella*, *Epistylis*, *Opercularia*, *Aspidisca* and *Chilodon*.

The authors thank Prof. V. Subrahmanyan and Dr. Gilbert J. Fowler for their keen interest in the work. Their thanks are also due to the Municipal authorities at Madura for their kind co-operation in the investigation.

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July 13, 1947.

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TAMARIND SEED POLYSACCHARIDE

DIVERSE views have been expressed regarding the classification of the polysaccharide of the tamarind seed kernel,[1,2,3] leading to confusion in the name of the substance.

The polysaccharide possesses the characteristic property of forming acid-sugar-jellies just like the fruit pectins. Unlike the latter, however, it is not derived from polygalacturonic acid; but it is a carbohydrate composed of xylose, glucose and galactose.[4] Further, it is capable of forming jellies under varying conditions of pH including neutrality.[5,6] It does not, therefore, strictly come under the class of pectins,[3,5] as defined in the Report of the American Chemical Society on Pectin Nomenclature.[7] Hence it is desirable, as already pointed out elsewhere,[8] either to enlarge the accepted definition of the word pectin so as to include substances of the type of the tamarind-seed product or to coin a new term to designate them. If the latter alternative were adopted, it would be desirable to choose such a term as would indicate not only the chemical nature of these substances, but also, if possible, their most important characteristic phyical properties. On the basis of these criteria, the name 'polyose' or 'hexopentosan', suggested by Savur and Sreenivasan,[3] does not seem to be satisfactory. The term "Jellose" appears to be suitable inasmuch as it indicates both the carbohydrate nature and the jelly-forming property of the substance. Jelloses, like pectins, gums and mucilages, may form a new group amongst the carbohydrates.

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June 1, 1947.

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WILT DISEASE OF GUAVA (*PSIDIUM GUYAVA* L.)

FOR the last few years a very high rate of wilting of guava plants has been observed in certain orchards in Lucknow. The result of the initial survey of orchards in and round about Lucknow and in certain districts of the U.P. showed that the disease is fast becoming a menace to the orchard owners. The problem was, therefore, taken up for pathological investigations.

In order to find out the time of incidence of the disease and the rate at which it advances, the guava trees of the Government Horticultural Garden were kept under careful observation during the year 1945 and 1946. The highest rate of wilting has been observed during the rainy season. The disease starts in August with the largest number of deaths in September and October. In November there is a marked decrease in the number of trees wilting, and with advancing winter the disease comes almost to a standstill (Fig. 1).

The symptoms are more or less same as described for the wilts in general for higher vascular plants. The first external symptom was yellow colouration of the leaves of terminal branch, which was followed by the drying of that particular branch. Simultaneously other

branches also wilted. Usually it took from ten to fifteen days for the complete wilting of the tree. An examination of the finer roots showed that some of them had black streaks which beame more prominent on removing the bark, while others were black uniformly.

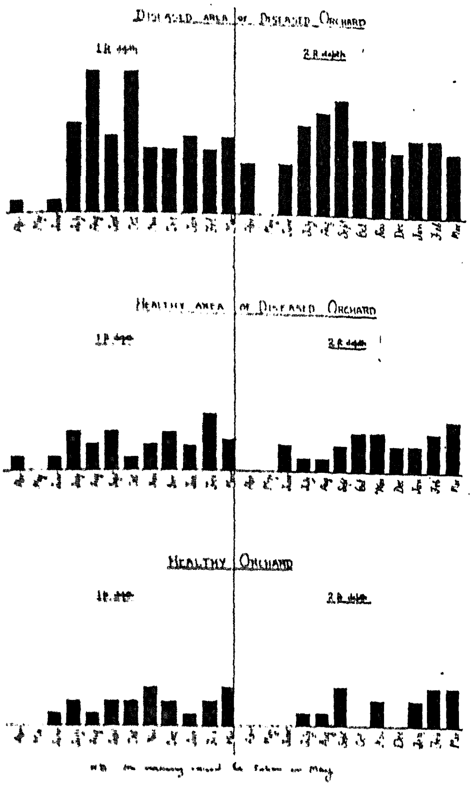

FIG. 2.

The nature of the disease indicated that it was due to root infection. Nevertheless isolations were made from different parts of root and shoot of diseased trees along with those of the healthy trees from the same orchard. The result of the isolation showed prevalence of *Fusarium* in the root system and the lower part of the shoot of the diseased tree, the upper part having certain other fungi. In very few cases a non-sporulating fungus was found associated with *Fusarium*.

The isolation experiments gave a strong indication that *Fusarium* was the cause of the wilt. Pathogenic tests were, therefore, carried out using monohyphal culture of the fungus on guava seedlings, one month, three months, one year and three years old. All the inocuiation experiments were made in potted plants, to the soil of which the *Fusarium* culture was mixed in a definite proportion.

The following table gives a summarised result of root inoculation with seedlings of different ages.

Treatment	Age of seedling	Average % of wilt
Inoculated ..	1 month	86·3
Control ..	1 month	nil
Inoculated ..	3 months	100
Control ..	3 months	nil
Inoculated ..	1 year	83
Control ..	1 year	nil
Inoculated ..	3 years	80
Control ..	3 years	nil

After the seedlings had wilted, an effort was made to reisolate the fungus from roots, and almost in every case the fungus inoculated was obtained.

Shoot and foliage inoculation was also tried by spraying the fungus dilution with an atomizer, and putting the inoculum on injured and uninjured surface of the leaves and stem but with no result.

For the purpose of correlation, a study of the soil microflora of the infected orchard during various months of the year was undertaken. The dilution plate method was employed for this study. Apart from several other Fungi and Bacteria that were obtained, a marked variation was found in the number of *Fusarium* colonies appearing during various seasons. The accompanying figure will give an idea of the distribution of *Fusarium* during different months of the year. (Fig. 2)

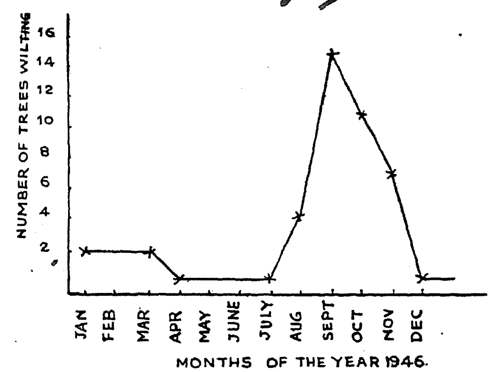

FIG. 1

Having established the pathogenicity of the Fungus, a study of the mechanism and physiology of wilt was undertaken. The work is still in progress; but the results so far obtained show that the fungus grown in liquid medium (Richard's solution) produces some toxic substance which causes wilt in the guava plants. Seedlings transferred to these solutions die readily. In twenty days' old culture solution, freed from the fungal growth by Seitz filter, the first symptom of wilt in one-year old seedlings was observed about 3 hours after their transference, and within 10 to 12 hours they

were completely wilted. Seedlings kept in Richard's solution (uninoculated) as control remained unaffected.

The detailed paper will be published shortly.

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THE NEST OF A RESIN-WORKING SOLITARY WASP

A wasp nest built entirely of resinous substance was noticed on the door of a bath-room at Namkum, Ranchi. The nest consisted of eight round and about thirty oval cells. The round cells, with circular openings, were semi-elliptical in section, 12-13 mm. in diameter and 9-10 mm. deep. The oval cells were 13-14 mm. long and 5-6 mm. broad. The rough surface of the cells were made up of lumps of resin, mostly of hard pale yellow and some soft brown, arranged in concentric rings. The cells, on breaking, smelt strongly of gum benzoin. The walls of the cells were quite hard and brittle, and found varnished with a whitish glistening substance, probably secreted by the wasp grub before pupation. The nest resembled that of the typical 'mud-dauber' or 'potter', and probably was constructed by one of the Eumenid wasps.

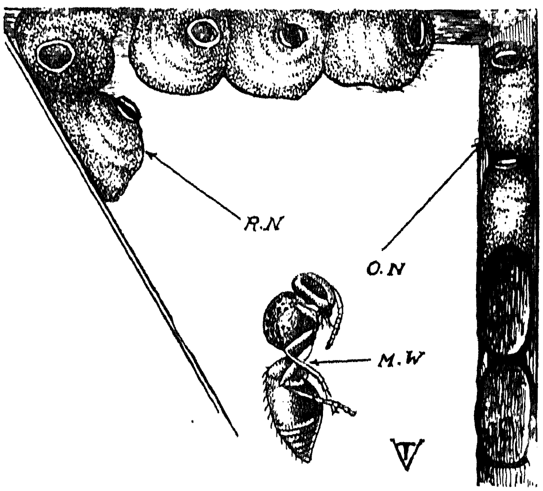

FIG. 1. Showing resin wasp nests on door (nat. size) R. N.—round brood cells; O.N.—oval brood cells; M.W. Mutillid wasp, female, × 3.

All the cells except four with dead adults of a species of Mutillid wasp (*Mutilla* sp.), were empty. The female Mutillid is wingless; head and thorax black and coarsely rugose; ocelli wanting; abdomen with black pubescence; the lower margins of first and second abdominal segments with narrow transverse bands of glittering golden hairs. The male is winged; ocelli present, three in number on vertex; mandibles slightly bent and tridentate; patches of golden hairs present on head and thorax in addition to bands on abdomen. The Mutillid wasps are probably parasitic on the immature stage of the Eumenid wasp which build the resin nest. The majority of species of Mutillid wasps are found parasitic on *Aculeata hymenoptera*; Maxwell-Lefroy[1] has recorded more than one species of *Mutilla* parasitic on Eumenid wasps in India. Some of the empty cells contained remnants of caterpillars; apparently caterpillars were used as prey by the Eumenid grubs.

Little is known of the nesting habits of resin-gathering wasps in India. Maxwell-Lefroy mentions a Eumenid (*Rhynchium nitidulum* Fabr.) which makes a cluster of oval cells coated with a black gummy substance. Phil Rau,[2] in a recent paper on Mexican solitary and social Bees, states that the Megachilid Bees use resin only for plugs for the doorways and partitions within the cells of old nests of paper wasps.

The resinous substance is probably composed of resin and bark scrapings of plants chewed together and mixed with the saliva of the wasp. Seven grams of the yellow resin from thirty cells were analysed.

Cold water has no effect on the resin. The extract with boiling water is pale greenish yellow. The extract did not reduce Fehling's solution, indicating the absence of reducing sugar. Boiling 95 per cent. alcohol extracts 86·6 per cent. of the resin. The alcoholic solution is acidic to litmus, evolves CO_2 from sodium bicarbonate solution and leaves a hard discontinuous film on evaporation. On dilution with water a colloidal solution is formed, from which the resin could be separated by the addition of an electrolyte like NaCl. This method was used to purify the resin.

Characteristics of the yellow resin from wasp nest

Softening point	96°–102° C.
Melting point	105°–120° C.
Acid value	39·3
Saponification value	80·17
Ash %	0·44

The alcohol-insoluble part consisted of a small quantity of fibrous material, white granular substance and some dust particles. This softened at 150° C., but did not melt properly. On ignition it left a white ash.

Destructive distillation of the resin yielded 47·5 per cent. of the resin as an oil with strong smell of gum benzoin, and refractive index, 1·502.

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April 25, 1947.

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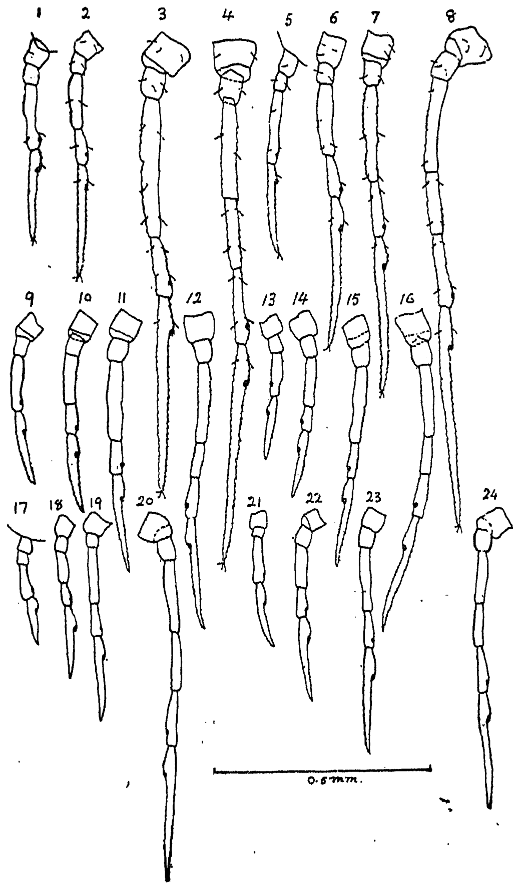
POST-EMBRYONIC DEVELOPMENT OF ANTENNA IN APHIDS

During the course of my study of the various nymphal stages of Aphids, I found that Saxena's[1] observations regarding the mode of post-embryonic development of antennæ of insects in general and *Bagrada picta* Fabre in particular are not in conformity with those of Fuller,[2] Bugnion[3] and Quadri.[4] Studies both

on the alate and apterous viviparous forms of the three species of aphids, *viz.*, *Aphis gossypii* Glover, *Rhopalosiphum pseudobrassicæ* Davis, and *Aphis nerii* Fonscolombe show that the mode of development of the antennæ is more or less similar in all these forms.

In the adult insect each antenna is six-jointed, mobile, filiform and beset with spines. A primary sensorium is situated on the top of the penultimate and another at the base of the ultimate segment, while the secondary sensoria are distributed from the third to sixth segments. The scape is the smallest and the ultimate segment, the longest.



FIGS. 1–8. Antennæ of the nymphal stages of Alate and Apterous vivparous females of *Aphis nerii* Fous. FIGS. 9–16. Antennæ of the nymphal stages of Alate and Apterous viviparous females of *R. pseudobrassicæ* Davis. FIGS. 17–24. Antennæ of the nymphal stages of Alate and Apterous viviparous females of *A. gossypii* G.

Just after hatching, the first stage nymph has four-jointed antenna. The scape and pedicel are nearly of equal length, while the fourth or the ultimate segment is the longest. The primary sensoria are present, one at the distal end of the third segment, the other at the base of the fourth. A constriction then begins to appear in the third antennal segment.

After the first moult the antenna elongates slightly. The scape and pedicel remain nearly of equal length. The constriction which started in the third segment of the first stage nymph becomes very clear, dividing the segment into proximal and distal portions, the former being longer than the latter. The antenna is now five-jointed, the ultimate segment being the longest. The primary sensoria in this stage are situated on the top of the distal portion of the third segment, which may be called the fourth segment and at the base of the ultimate segment, which now becomes the fifth segment.

The antenna in the third stage nymph elongates further, having five segments, the last being the longest. The primary sensoria are situated on the top of the fourth and at the base of the fifth segment indicating that these are respectively the future fifth and sixth segments of the adult. The third segment also increases in length, and a constriction again appears in it.

In the fourth stage nymph the antenna continues to elongate. The pedicel becomes slightly longer than the scape. The constriction which had started in the third segment of the previous stage divides the segment into two parts, the proximal portion being longer than the distal, making the antenna now six-jointed. The primary sensoria are situated on the same segments as in the last stage, the segment now being the fifth and sixth.

It is concluded that the pedicel does not divide in Aphididæ. In this family the post-pedicel elongates and becomes three-segmented by two successive divisions which take place in the second and fourth nymphal stages. These observations agree with those of previous workers[2–4] except of Saxena.[1]

I wish to record my thanks to Dr. Rakshapal, Lucknow University, for his valuable suggestions and correction of the manuscript for the press.

Entomologist,
Gwalior, C. B. L. BHARGAVA.
June 23, 1947.

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METABOLISM OF UNSTRIATED MUSCLE

STUDIES of the activity of frog's stomach muscle have shown that there are separate metabolic mechanisms for the production of mechanical activity under different conditions.

1. *Activity under anærobic conditions.*—The excitability of the muscle to alternating current (10 volts for 10 seconds every 1 minute), after a variable latent period, is at first increased and then depressed, and finally the muscle may be completely paralysed, though partial activity continues for a long time in the absence of oxygen. During this steady state, if oxygen is admitted, there is at first a depression before the response returns to normal; this depression may amount to complete paralysis—oxygen paralysis. These experiments suggest two mechanisms—for ærobic and anærobic conditions—in unstriated muscle, and

these two are mutually exclusive; this, in fact, is a Pasteur reaction.[1]

2. *Activity in acid solutions.*—Unstriated muscle may become hyperexcitable in acid solutions (pH 6·5). In alkaline solutions, glucose has a beneficial effect, but this becomes less marked in acid solutions. As a matter of fact, in acid solutions, pH 6·5, the effect of glucose may be inhibitory. This differential effect of glucose suggests that there are different metabolic mechanisms in alkaline and acid solutions respectively.

3. *Tonic and twitch contractions.*—If by repeated stimulation in the absence of oxygen, the muscle becomes fatigued to alternating current, the addition of potassium ion (20 per cent. of the sodium of the saline replaced with potassium), produces a powerful contraction, and the excitability to alternating current also greatly increases, so that the asphyxial paralysis is abolished. This effect is produced by all substances that produce tonic contraction. These experiments suggest that there are different metabolic mechanisms for tonic and twitch contractions but the energy released by the former is utilisable by the latter.

4. *Tonus.*—Oxygen consumption experiments have shown that there are two kinds of tonic contractions, one that uses oxygen and the other that does not.[2,3] This has been confirmed by the finding that there are two kinds of tonic contractions, one that decreases and the other that increases in the absence of oxygen. As a matter of fact, it is possible for unstriated muscle to maintain considerable tension for several hours in the absence of oxygen and die in the contracted state; this tonic contraction appears to be identical with asphyxial rigor in striated muscle. One kind of tonic contraction of unstriated muscle appears to be identical with contracture of striated muscle; this uses oxygen. The other kind of tonic contraction, which does not use oxygen, appears to be related to rigor mortis of striated muscle. Contractions of striated and unstriated muscles are thus closely related.

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MRS. SUNITA INDERJIT SINGH.

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Karachi,
June 9, 1947

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EFFECT OF DIFFERENT NUMBER OF TILLERS ON THE QUALITY OF PRIMARY (*MOTHER*) SHOOT IN SUGARCANE

PRIMARY (mother) shoot in sugarcane is already known to be of superior quality than its tillers.[1,2] The effect of different numbers of tillers on the mother-shoot is, however, not fully known. Experiments in this direction were carried out at the Main Sugarcane Research Station, Shahjahanpur, during 1943–44 and 1945–46 with Co. 527 and CoS. 146 respectively. Five hundred primary shoots were tagged in the February-planted crop during the month of April. Subsequent tillers were labelled as they emerged. The primary shoots (A to D) were divided according to the number of tillers, 0 to 3, with the plants into 4 treatments.

Tillers that followed above the quota of the respective treatments were cut out every week, and only plants that acquired their treatmental quota of tillers by the middle of July were selected.

The different kinds of primaries and tillers were examined for juice quality during the crushing season with 10 canes coming from 10 different plants for each sample.

TABLE I

Showing quality of different kinds of primaries and their secondary shoots

Treatments	Co. 527 (1943–44)		CoS. 146 (1945–46)	
	Sucrose %	Purity	Sucrose %	Purity
A-Primary shoots	13·38	79·78	19·70	89·32
B-Primary shoots with 1 tiller	14·51	84·01	20·45	89·58
1. Primary shoots				
2. 1st tiller ..	14·19	81·68	19·88	88·02
C-Primary shoots with 2 tillers				
1. Primary shoots	14·85	84·80	20·53	90·59
2. 1st tiller ..	14·05	80·88	20·14	89·50
3. 2nd tiller ..	12·86	78·55	19·98	89·08
D-Primary shoots with 3 tillers				
1. Primary shoots	..	..	20·69	90·07
2. 1st tiller ..	..	..	20·54	89·97
3. 2nd tiller ..	..	..	20·40	89·35
4. 3rd tiller ..	..	..	19·84	89·35

The above data not only further confirm the view that the primary shoot is superior in quality than its tillers, but also make it clear that the larger the number of tillers the better the quality of the primary shoot.

My thanks are due to Dr. A. K. Mitra for his valuable help in planning this experiment, and to the Indian Central Sugarcane Committee for financial assistance.

Main Sugarcane Research Station,
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June 30, 1947.

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Jeffreys. (Cambridge University Press),
Pp. 679 + vii. Price 63 *sh*.

gh there are books in other languages, rly in German, designed specifically to e mathematical needs of physicists, been so far no such treatise in English, broadly the various branches of pure tics that are often required in prob- advanced physics. The book under s intended to fill this gap. An idea of e of the book may be gathered from wing table of contents: 1. The Real 2. Scalars and Vectors, (3. Tensors, ces, 5. Multiple Integrals, 6. Potential 7. Operational Methods, 8. Physical ons of the Operational Method, nerical Methods, 10. Calculus of Varia- 1. Functions of a Complex Variable, our Integration and Bromwich's Inte- . Conformal Representation, 14. Fou- eorem, 15. The Factorial and Related s, 16. Solution of Linear Differential s of the Second Order, 17. Asymptotic ns, 18. The Equations of Potential nd Heat Conduction, 19. Waves in One n and Waves with Spherical Symmetry, uction of Heat in One and Three Di- , 21. Bessel Functions, 22. Applica- Bessel Functions, 23. The Confluent metric Function, 24. Legendre Func- Associated Functions and 25. Elliptic s.

nior author of the book has already a tract on "Operational Methods in tical Physics," which did useful ser- eviving interest in Heaviside's methods years. Much of the matter contained ook finds a place in the present work, ly in Chapters 7 and 8. In fact, a eature of the book is the systematic n of operational methods for solving ential equations that occur in the vari- lems, and even in the treatment of cases such as Bessel's equation. The of the first chapter on the theory of of the real variable has increased bly the clarity and rigour of the later The book contains numerous appli- f the methods developed to problems cs, particularly in potential theory, , electromagnetism, heat conduction, ion, etc. There is, however, compara- le reference to applications in modern such as relativity theory and quantum s. For instance, the chapter on tensors contain even an introduction to the differential calculus. It is felt that ion of a few more pages dealing with s of differential geometry and of group nd subjects allied to them such as lculus, theory of transformations and algebra would make the book more and useful to students of modern l physics.

On the other hand, the book covers quite a large field of mathematics and contains many things that one would not normally expect in a work of this type. One such, as already mentioned, is the detailed treatment of operational methods. Another is a brilliant chapter on numerical methods, which would be of great help in the usual computations accompanying theoretical investigations. The chapter contains practically all the salient details of this subject in the brief space of 50 pages. Most of the higher functions that occur in mathematical physics, such as the factorial, Bessel, hypergeometric, elliptic, Legendre, etc., are discussed in good detail. In this, the authors have boldly used new definitions of the various functions, so as to secure greater symmetry in the expressions, as also simpler relations between different functions.

The following errors and misprints may be noted: (1) In p. 18, it is stated, "It is a matter of definition whether we say that $f'(x)$ does or does not exist when $\{f(x+h)-f(x)\}/h \to \infty$; we shall usually say that it does not." As contrasted with this, see p. 28, line 4, 'The derivative exists, but is unbounded'; (2) in the chapter on Legendre functions, it is never stated that μ stands for cos θ, although the relation is used throughout the chapter; (3) in p. 158, line 2, the Jacobian is inverted; (4) in p. 314, the definitions for closed and open intervals have been interchanged; (5) in p. 420, Eq. 12, the right-hand side should contain a factor $\frac{1}{2}\pi$. These, however, do not in any way detract from the merits of the book, which will be found to be a very useful reference book by all workers in theoretical physics. The printing and get-up are good and come up to the usual standards of the Cambridge University Press. The cost is perhaps a little beyond the means of individual students, which is unavoidable with a book of this size. The reviewer, however, warmly recommends the book to every library in advanced physics.

G. N. RAMACHANDRAN.

A Practical Course in Agricultural Chemistry. By F. Knowles and J. E. Watkin. Second Edition. (Macmillan & Co.), 1947. Pp. 216. Price 12/6*d*. net.

The present publication is the second edition of a book which first appeared in 1937. The authors, who are well known in the profession and long associated with teaching and research, have made extensive revisions so as to make the methods fairly up-to-date. The book is a useful compilation, and, apart from its value to the student going up for degree examination, it is also quite serviceable as a refresher to research workers and others who are not in a day-to-day touch with the various methods.

As stated by the authors in their preface, the book is mainly intended to give an outline of the various methods employed in soil science,

plant biochemistry, dairying, horticulture and poultry husbandry—all of which are studied for the degree course. The methods are naturally quite numerous and highly varied in character. The wide scope necessitates brevity in description, and although here and there even elementary principles are explained, the main text of the book would require a fairly good background of chemistry.

It is presumed that the selected methods are intended to be such as can be tried out in a laboratory with minimum equipment. The method of Walkley and Black recommended for the estimation of carbon has the advantage of ease and simplicity, but it cannot be regarded as accurate. Other methods, easily adaptable to laboratory conditions are also available. In some cases, the authors have stuck to some of the older methods, though others have, not only advocated but also found, some of the modified and newer methods to be more useful. Thus, although the previous moistening of the soil with water helps in the Kjeldahl digestion and yields consistently more dependable results (especially in the case of heavy soils), there is no reference to it. The Fiske-Subbarow method of colorimetric estimation of phosphorus has not been recommended though it is the most popular method for micro-quantities at the present time. The use of bismuthate for the estimation of manganese has not been cited. Similarly, there is no reference to the use of oxyquinoline for the estimation of some of the elements, especially aluminium. These are, of course, inevitable when the size of the book is restricted and the authors have to cater mainly to students who do Agricultural Chemistry as one among several subjects.

The book has been well written with a practical insight into the actual requirements of the users. Sir John Russell has paid a well-deserved compliment in his introduction to the book. The printing is excellent, in keeping with the high traditions of the publishers. The book will be found very useful by students of Agricultural Chemistry over different parts of the world. V. SUBRAHMANYAN.

Chemistry of Vitamins and Hormones. By S. Rangaswami and T. R. Seshadri. (Andhra University, Waltair, South India), 1946. Pp. 329. Price Rs. 7-8-0.

Biology and medicine are greatly indebted to the science of organic chemistry for the rapid advances which they have registered in their respective fields. The entire subject of vitamins and hormones is of so recent an origin and has progressed at such bewildering speed that it has become impossible for an interested worker to keep pace with all the important publications dealing with this subject. The discovery, isolation and synthesis of most of these substances have led to the widening of the scope of their application and have contributed to a better understanding of many biological processes.

Much of the credit for this goes to the organic chemist, for it was his tribe that made it possible to produce in large amounts these of the theory underlying the *Chakravala* pro- physiologically active substances and also to find simpler, cheaper and sometimes more active substitutes prepared synthetically. From the point of view of budding organic chemists, this book is an admirable one. There are described the more important stages of earlier work on each vitamin and hormone. The descriptions of properties, structure and synthesis follow in each case where they are definitely known. The account dealing with physiological function and methods of assay is also well written. The book will be of immense use not only to the students taking their degrees with organic chemistry as special subject, but also to those investigators who need from time to time information of the kind found in the book, all in one place. V. N. P.

A Chapter in the Theory of Numbers. By L. J. Mordell. (Cambridge University Press), 1947. Pp. 31. Price 1/6*d*.

This forms the subject-matter of an inaugural lecture given at Cambridge by the author, and contains a historical review of the attempts at finding the integral as also rational solutions of the equation $y^2 + K = x^3$ and allied problems. Particular cases of K, like $K = 2$, $K = -17$, are famous problems, adaptable to elementary methods. The theory of algebraic numbers has greatly advanced our knowledge of the subject. The most general equation $y^2 = x^3 + K$ which has no rational solutions is a problem still awaiting solution. C. N. S.

Ancient Indian Mathematics and Vedha. By L. V. Gurjar. (Ideal Book Service, Sadashiv Peth, Poona). Pp. 202. Rs. 6-4 or 10 *sh*.

Books on the history of Ancient Indian Mathematics written in English or for the matter of that in any Indian language are so few that any new book brought out has its due place and use. Indian mathematicians and historians justly resent that the achievements of ancient Indian mathematicians are not given proper recognition in books on history written by Westerners. Several Western savants have done valuable service in translating or interpreting the writings of Aryabhata, Brahmagupta and Bhaskara. But how many books on the history of mathematics written in Europe and America refer to the value of $\pi = 3 \cdot 1416$ as first given by Aryabhata, or to Bhaskara's work on indeterminate equations, or to India's contribution to the algebra of combinations? The need for suitable books written by Indians themselves is thus manifest; but no useful purpose is served by one's crying from the house-top about the "glorious and profound researches" of ancient Indians, without presenting a succinct and scientific account of these researches. Mr. Gurjar's book is, from this point of view, disappointing. He would have better served his brief for the Indian cause, if he had set forth the mathematical justification of the more advanced results of the Indian scholars. For example, one would except in the book a comparative discussion of the methods of Aryabhata, Brahmagupta and Bhaskara with respect to *Kuttaka*, of the theory underlying the Chakravala process and so on. Even from the historical point of view, the book is not free from defects. Most of the geometry found in Aryabhata was known to the Jains of the pre-Christian era.

There is no mention at all about India's contribution to the theory of permutations and combinations, about Bhaskara's work pertaining to the notion of the differential calculus, and about Indian methematics after Bhaskara, especially of the Malabar school.

The author is well versed in Sanskrit, and is a Professor of Mathematics. We would earnestly suggest to him to rewrite this book, or to write a bigger book, with less of superlatives but with more of mathematics.

C. N. S.

The Methods of Cellulose Chemistry. By Charles Dorée. Second Edition (revised and enlarged). (Chapman and Hall Ltd., 37, Essex Street, London, W.C. 2), 1947. Pp. 543. Price 42 *sh*.

The experimental investigator has always felt the need of a handy book giving full experimental details of specialised methods for the study of Cellulose in its various aspects as a primary constituent of plant cell, as a chemical entity and as a structural colloidal unit. In the preparation of this edition, Dr. Dorée has admirably succeeded in this task of providing "full working details of a selection of the subject". The material is grouped under three sections dealing with normal cellulose, its synthetic derivatives and compound celluloses. It is hoped that this edition will be readily welcomed by the student who is undertaking research in the extensive field covered by cellulose and the natural constituents associated with it in the plant world, as well as by the workers in commercial laboratories controlling and investigating the manufacture of cellulose products.

The technique associated with X-ray investigation of cellulose has, however, been omitted. It could have been included with advantage at least in this edition, as Röntgen's graphic methods of investigation of natural products are finding favour even in this country.

P. L. N. Rao.

Journal of the History of Medicine and Allied Sciences, Vol. 1, No. 1. (Henry Schuman, New York), 1946. Price $8.50 per year.

This quarterly is devoted to the publication of work relating to all aspects of the history of medicine, public health, dentistry, nursing, pharmacy, veterinary medicine and allied sciences which impinge on medicine. The first number of this new venture is prefaced by an interesting article arrestingly entitled, "What is past, is prologue", contributed by Editor Rosen, who has emphasised the importance and value of history as one of the most powerful driving forces in human development. In the solution of difficult and intriguing problems which confront us, the historical approach often facilitates solution. A knowledge of not only the past achievements but also the mental processes, the ideological and philosophical conflicts which inspired the action and economic and political background against which the event was enacted is helpful for envisaging and planning a rationalised future. "Without sound historical knowledge, men act instinctively and emotionally but not rationally."

According to the Editor, medical history is to be cultivated not "as a mere search for antiquities, as a kind hunt for curios, but rather as a vital, integral part of medicine.

The number under review contains 11 contributions including the prefatory prologue to which reference has already been made. Personal reminiscences and achievements of some of the old world pioneers of medicine and pharmacy, medical education in the 17th century England, incubator and taboo, animal substances in materia medica, are some of the subjects discussed in the number. An interesting and perhaps an unusual feature of the journal is the "Notes and Queries" which is included to "provide a medium of communication between readers with unsolved problems and readers who can solve them". Book reviews and notes on contributors are the other features of the journal. The enterprise is supported by a panel of consulting Editors representing different interests and different parts of the world. India and China possess a rich tradition in medicine, and the international status of the journal would be raised by inviting representatives of these two countries to join the panel. The journal will no doubt be widely welcomed not only by the ever-expanding circle of the medical profession but also by historians of science. We wish the journal a long and purposeful career.

M. S.

The New Genetics in the Soviet Union. By P. S. Hudson and R. H. Richens. (Imperial Bureau of Plant Breeding and Genetics.)

The history of development of genetics during the first thirty years of the present century was marked by a general uniformity in the fundamental conceptions of the science in all countries including Russia. About the year 1930, however, there sprang up in Russia a new school headed by the Ukrainian botanist, Lysenko, and supported by a very able philosophical writer, Prezent, and a body of agriculturists and plant breeders, which was in the main antipathetic to the old school. The new school derived its inspiration from the philosophy of dialectical materialism and the speculative writings of Darwin, Micurin and Burbank, and postulated a system of genetics in which the environment was assigned the chief role in the determination of the hereditary constitution of organisms. According to Lysenko, "Hereditary constitution is, as it were, a concentrate of the environmental conditions assimilated by the plant organisms in a number of preceding generations".

This was in direct contrast to the generally accepted system of genetcis based on Mendel's laws and chromosome theory of heredity, and hence provoked a fierce controversy in Russia which centred mainly round Lysenko representing the new school and Vavilov, the old. After ten years of acute controversy the school of Lysenko appears to have gained the ascendency, and the Mendelian point of view became less popular in Russia.

The genetics controversy in Russia naturally excited world-wide interest among geneticists, but the full facts were not well known outside Russia. This was largely due to the inaccessibility of evidence, which lie scattered in the larger volume of scientific Russian literature,

and the absence of an impartial and critical account of scientific development in that country. There were, however, a few attempts to review the position, but they were often marred by the expression of strong sentiments either for or against the Russian situation.

Dr. Hudson and Dr. Richens have done a great service to the geneticists outside Russia by the publication of this bulletin, which gives a critical and impartial account of the origin and development of the new school in its proper perspective. Purely scientific matters in Russia are so much mixed up with historical, philosophical, political and psychological issues that, without a proper appreciation of such a background, it is not easy to account for the development of unorthodox theories like that of Lysenko. The authors have analysed critically the components of modern Russian genetics and presented a clear picture of the new vocabulary, conceptual system and general outlook of the new school.

The bulletin contains six chapters which deal with the historical background in which the theories of the Russian school were developed, the psychological motives underlying their enunciation, the various tenets of Lysenko's genetic system including his 'nutrient' theory and the experimental and theoretical evidence on which they are based. The last chapter deals with Lysenko's arguments against genetics as ordinarily understood. In dealing with these aspects the authors have drawn attention to the defective methods of experimentation, a logical treatment of scientific subjects and a complete antipathy to the application of statistical methods to quantitative data, which have characterised the Lysenko school. The authors also point out that many of its criticisms of classical genetics are out of date and proceed from an ignorance of the latest advances in the subject outside Russia.

The bulletin concludes with a summary in five languages, *viz.*, English, French, Spanish, German and Russian, and an extensive bibliography of about 300 references.

S. Ramanujam.

Rotary Guide to Careers. (Oxford University Press), 1947. As. 8 each.

These are a series of pamphlets issued under the auspices of the Vocational Service Committee of the Bombay Rotary Club and are intended to be guides to the different professions open to youngmen. They are modelled on the pamphlets issued by the Ministry of Labour and National Service in Great Britain, with due regard to conditions and facilities obtaining in India to-day. The information given in these pamphlets includes, advice on the personal and educational qualifications, the opportunities and essential training required, and would, therefore, be most useful to all those who are keen on taking up a professional career.

Pamphlets dealing with (1) Architecture, (2) Banking, (3) Law, (4) Accountancy, (5) Engineering, (6) Civil Engineering, (7) Mechanical Engineering, have already been published. A few more are expected to be published soon. They deal with cotton—raw and Textiles—Civil Aviation and Air Services, Chemical Engineering, Electrical Engineering Librarianship, and Stock, Bullion and Exchange Broking.

The printing and get-up of these pamphlets is very good.

H. N. R.

International Council of Scientific Unions Vol 4. Edited by F. J. M. Stratton. (Cambridge University Press), 1946.

This volume, like the previous ones, is a report of the proceedings of the fourth general assembly of the Council held in London in July 1946. The I.C.S.U. is the successor of the pre-war International Research Council. It is the supreme body in the domain of natural science, and the international bearer of authority of all the national academies of sciences, even as the latter are the most influential organisations in their respective territories. Moreover, the I.C.S.U., according to its name, has all the International scientific unions affiliated to it. Although it is not the dictatorial authority of the several bodies, it is empowered to demand the co-operation of them all in the huge task of symmetrical development of all sciences wholly and solely for the benefit of mankind.

The primary functions of the I.C.S.U. are "to assist at the birh of new international Scientific Unions, to mature the young or weak among the sectional unions and to co-ordinate the activities of the established organisations". The I.C.S.U. performs other important functions as well. It directs international scientific activity in subjects which do not fall within the purview of any existing international association, and calls into existence joint commissions of two or more unions to be active in the intermediate provinces of sciences, like, for instance, oceanography, between the unions of Geodesy, Geophysics and of Biological science, or *Ionosphere*, between physical unions and those of Geodesis and Geophysics.

The criticism that has been directed against the inequitous attention paid by the I.C.S.U. towards that part of the world which is more advanced in science appears to be quite just. The defence of such a policy by the President on the specious plea that the I.C.S.U. forms a "Scientific Church" and not a "Mission" only succeeds in dwarfing the world stature of the organisation, and deprives it of its unique position and opportunity to lead the nations into amity and prosperity by adhering to the most pervasive faith in the world—the religion of the pursuit of truth for its own sake.

K. S. R.

SCIENCE NOTES AND NEWS

Grant for Research in Hyderabad.—The Nizam's Government have sanctioned a non-recurring grant of Rs. 15,00,000 and a recurring annual grant of Rs. 2,76,000 for the Central Laboratories for scientific and industrial research in Hyderabad. -Orders for the equipment required have been placed in the United States of America, and are expected to arrive shortly. The Central Laboratories, besides functioning as the testing and research unit, give technical help and advice to the general public, industrailists, and various Government Departments. They will have their permanent buildings near the Osmania University, and 56 acres of land have been acquired for this purpose.

New Comet Seen.—The discovery of a new comet—visible with the aid of a moderate telescope—was reported to the Harvard University Observatory.

The comet is in the 12th magnitude and was sighted on July 18 and July 23 and Mr. C. A. Wirtanen at Lick Observatory, San Jose, California. Comets, generally, are not visible without the aid of a telescope beyond the sixth magnitude.

Mr. Wirtanen described the new comet as "diffused with its central nucleus" the constellation Wauarius. He believed it would be visible for some weeks.

The Indian Mathematical Society.—The 15th Biennial Conference of the Society will be held at Waltair, Madras Presidency, under the auspices of the Andhra University, from 22nd to 24th December 1947.

Members wishing to read papers at the Conference are requested to send their papers along with a short summary to Prof. A. Narasinga Rao, Department of Mathematical Physics, Andhra University, Waltair, so as to reach him on or before 15th October 1947.

Prize Problem in Mathematics. The Indian Mathematical Society has proposed the following problems for the *Narasinga Rao Medal—Mathematical Research in* 1948.

To make a contribution to the theory of plane projective geometries, particularly the following types of non-desarguesian geometries:

(1) The geometries where a single (p, L) Desargues' Theorem holds where L is a line passing through the point p. [The (p, L) Desargues' Theorem states that if the three joins of the corresponding vertices of 2 triangles concur at p, and if two pairs of their corresponding sides intersect on L, then the third pair also intersect on L].

(2) The geometries in which there is a transitive group of translations.

(3) The geometries in which the theorem of the complete quadrangle (that is, existence of a unique harmonic conjugate C′ of C with respect to AB for every triad of collinear points) holds.

(4) The required "contribution" is to bear on the following questions :—

(*i*) The distribution of points p and lines L passing through p, such that the (p,L) Desargues' Theorem is true, the distribution of collinear triads of points A, B, C, such that C has a unique harmonic conjugate with respect to AB.

(*ii*) The distribution of quadrangles with three collinear diagonal points.

(*iii*) The projective group of the plane and the projective groups of its straight lines.

The solutions of the prize problem are to be sent to the President of the Society at the time, and the last date for the submission of the theses is the 1st July 1948.

For further particulars and references to literature on the problems of research apply to :—Dr. A. Narasinga Rao, Editor, *The Mathematics Student*, Andhra University, Waltair.

All-India Board of Technical Studies.—With a view to attaining uniform standards in Engineering Education, the All-India Board of Technical Studies in Engineering and Metallurgy have instituted in the first instance Diploma and Certificate courses in Electrical Engineering.

The All-India Diploma course is a full-time three-year course in an affiliated Institution followed by one year of practical training. The Diploma has been provisionally recognised by the Federal Public Service Commission for admission to examinations held by them for recruitment to certain posts under the Government of India.

The All-India Certificate course is a part-time course of three years' duration. Persons employed in workshops and industry are eligible for this course which enables them to acquire further knowledge in subjects relating to their profession.

National Institute of Sciences.—At a meeting of the Council of the National Institute of Sciences of India and the Fellows of the Institute held in Bombay on the first of August, Pandit Jawaharlal Nehru was elected Fellow of the Institute.

The meeting assured Pandit Nehru of their full support in the tasks of raising the lot of the people and the scientific development of India and expressed the hope that they could count on his active participation in the activities of the Institute.

Central Medical Institute.—India will have a unique organisation in the Central Medical Institute to be established at the cost of five crores of rupees.

Blueprints for the Institute, first suggested by the Bhore Committee, have been worked out in a report prepared by a Committee presided over by Sir A. Lakshmanaswami Mudaliar. The Institute, which is to be located in Delhi, will be primarily an advance research and training centre. The model adopted is that of

the famous Johns Hopkins Medical College in U.S.A.

The Institute will be built over a period of ten years at a capital cost of five crores of rupees, and an annual recurring expenditure of Rs. 56 lakhs will be incurred. It will have a 1,000-bed hospital attached to it. The Government of India are considering the report.

Food Technology.—The Rice Technology Committee has recommended the use of parboiled rice in place of raw rice as the former gives a higher yield of the whole unbroken rice, has more nutritive value and has better keeping qualities than raw rice. In view of the world shortage of rice a greater out-turn of whole parboiled rice should be of great significance in India's rice economy. The Committee also recommended the standardization of the parboiling process in India.

The Food Processing Committee has recommended further research on the processing of seed-cakes and the pilot plant production of soya-bean milk.

Adhesive for Plywood Industry.—The Forest Research Institute, Dehra Dun, has taken out a patent for the manufacture of prolamin adhesive which is extracted from gluten, a by-product of starch factories. This adhesive is of unique importance to the Indian Plywood Industry, and in spite of its low cost approaches phenolformaldehyde synthetic resin in efficiency.

Aluminium Production in C.P.—It is officially stated that the Provincial Government has decided to establish a factory for the production of aluminium in C.P. Of the raw materials required, bauxite of suitable quality is available in plenty.

This province has enough coal resources, and electricity can be generated at an economic rate. The establishment of this industry, it is stated, will result in the setting up of rolling mills and fabrication units and in the manufacture of titanium and aluminium powder pigments.

Chemical industries as sulphuric acid, required also for super-phosphate manufacture and caustic soda, will follow as a natural corollary.

Expedition to Tongaland.—Tongaland in Zululand, near the Portuguese border, is a storehouse of immense value to the scientist. It is through this very inaccessibility, however, that so little is known of the territory or its potentialities.

A representative body of scientists will carry out a geographical, zoological and botanical investigation to determine its potentialities for field studies and for scientific research and education. The expedition will also investigate the area's suitability as a nature reserve and the best way of opening it for visitors.

From a scientific point of view great importance attaches to the extensive fossil beds in the Ndumu area. This area is best known for its ammonites (fossilised molluscs with distinct tentacled heads). Of outstanding interest to scientists also is the investigation which will be made to determine, if time permits, the area in Northern Zululand where tropical flora and fauna integrate with the sub-tropical.

It is well known to scientists that many forms of tropical flora and fauna disappear in the vicinity of Hluhluwe Reserve. The best known example of this is the tsetse fly, whose depredations, so widespread in tropical Africa, in the Hluhluwe and Unfolosi area, disappear.

Experiments with Foreign Paddy.—An imported variety of Chinese paddy cultivated in Kashmir, is reported by the I.C.A.R. to yield twice as much as the local varieties. While this does not need artificial manure, the soil fertility is to be maintained with green and farmyard manure.

Of the other types of paddy imported into India some years ago, the Russian variety has been harvested about six weeks earlier than the indigenous kind. There are great possibilities of this rice being grown on high altitudes between 7,000 and 9,000 ft.

GEOMAGN ETICACTIVITY

Geomagnetic activity during the quarter April-June 1947 was very much on the decrease as compared with the previous quarter. Some details of the geomagnetic disturbances recorded at the Alibag Magnetic Observatory during the quarter April-June 1947 are given in the following table in which t_0, t represent the time (I.S.T.) of commencement of the disturbance and its intense phase respectively, and T the duration of the intense phase expressed in hours. The ranges in the three different elements (D, H and V) of the earth's magnetic field have also been given, D, in minutes of arc, H and V in γ where $1\gamma = 10^{-5}$ gauss. The maximum k-index recorded during the disturbances have also been given.

Date	t_0	t	T	Range			k_m	Nature of commencement
				D	H	V		
1947—	H. M.	H. M.	Hrs.	Min.	γ	γ		
April 17–18 ..	17 54	01 08 on 18th	$3\frac{1}{2}$	9·8	420	103	8	Sudden
May 24	07 42	12 15	3	4·9	225	51	7	Sudden
June 5	12 56	12 56	2	4·9	198	51	6	Sudden
June 13–14 ..	23 20	08 30 on 14th	7	9·3	143	86	6	Sudden

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THE SCHEME WORKER

THE establishment of the Imperial (now Indian) Council of Agricultural Research in the thirties marked the realisation of the grave backwardness of Indian agriculture and the lack of systematic effort at tackling problems peculiar to the indigenous plant-industry. The Council of Scientific and Industrial Research was its counterpart, started during the war, to answer the growing needs of Indian industry. The Indian Research Fund Association, a similar body dealing with the health and nutrition of the people, has been in existence for a much longer period.

These organisations sort out and allot for solution specific problems, in the form of *Schemes of Investigation*, to qualified men to be worked out either in the Council's or other laboratories in the country—all, on the advice of experts in the respective fields. The Scheme Worker can be defined as a trained worker with a set problem, determined to find a solution in a limited period of time, and receiving emoluments generally more than a stipendiary and less than a permanent staff member. Such employment of workers, as conditions of service now stand, involves no obligation on the part of the Councils to ensure continuity and security of employment to the workers, irrespective of the outcome of investigations entrusted to them. This is, to say the least, hard on the workers. In such an atmosphere the worker will have to be either on the look out for fresh problems for *schemes* that "appeal" to the Councils or for permanent posts which he must need secure before he exceeds the official age bar. This state of constant anxiety, it will be appreciated, is not exactly conducive to high morale resulting in the best output—either in quality or quanity—of scientific research. For, the most successful and lasting solutions and discoveries have got to be backed by years of concentration on specialised fields of investigation. The hunt for new schemes and lucrative employment in any field, on the other hand, cannot but fritter away the enthusiasm and collected experience of young scientists who would, given the chance, willingly work for Science and Country. Instances are common of promising workers who had to enter into routine non-technical professions

merely for want of encouraging scope in *schemes*—a waste we could ill-afford at the moment. By this, we should not, however, like to be taken to imply that this system has not been a success. On the contrary, it has to its credit the large success of the war effort and many an innovation and invention useful for improvements in agriculture, dairying, industry, health and epidemiology. But we should like to emphasise that the success has been in spite of the none-too encouraging rewards from the promising results of schemes.

It must, however, be said for the Indian Councils that the funds at their command have not been so munificent and their experience so ripe as to expect flawless organisation and administration in these matters. So far, they have been more or less makeshift arrangements. But it is now quite clear that each of these Councils—and more that are to come—need a standing army of trained scientists each with a specific branch of applied science for his life-work. If we are, therefore, to expect efficiency and loyalty from those who would devote themselves to fruitful careers of scientific research in the service of the Councils—and, therefore, ultimately of the nation—we cannot grudge security of employment and fair wages in return.

To plead in this strain for the Scheme Workers is not to invite the Councils to offer every entrant a sinecure. For, we admit, it is not given to every college graduate to become a successful scientist endowed with an analytical research mentality, no more than for every paint-dauber to become an accomplished artist. The *scheme* will, therefore, have its place as a period of training and trial under a critical teacher. And this period could be reckoned as a continuation of the academic training of the candidate. But, having sifted the grain from chaff, fair and encouraging conditions of service must be offered to the worker.

We may venture to suggest that this is a subject that could be taken up by the newly formed Association of Scientific Workers with the Councils of Research. We have reason to hope that the Government will, both in the interest of rapid development of the country and of justice to the Scheme Worker, generously treat the scientists, on whose contentment and enthusiasm depends to a degree the pace of material progress of the nation.

INDIAN SCHOOL OF MINES—EXPANSION

THE Indian School of Mines, Dhanbad, is to be called, hereafter, the Indian School of Mines and Applied Geology. Steps towards its re-organisation have been recommended by the Committee appointed by the Government of India in a report, which has been just published.

The Committee has formulated proposals for the extension of the activities of the School, for an increase in the annual intake of students and generally for raising the School to the standard of the Royal School of Mines, London.

Recognising the increasing demand for mining engineers and geologists in the country the Committee recommends that the annual intake of the School should be increased gradually from the present total of 24 to 60, consisting of 48 mining and 12 geology students. Admission will continue to be through an entrance examination, and candidates at this test should have taken physics and chemistry at the Intermediate or equivalent examination. The Committee recommends also the abolition of the three-year certificate course, as a result of which all entrants will be required to take the full four-year course leading to the granting of the Diploma in either Mining Engineering or Geology.

Revision of Curricula Suggested

The Sub-Committee appointed for the revision of curricula has made special recommendations in which they insist that subjects like fuel technology, oil technology, refractories and ceramics, metallurgy, and geophysical prospecting should be given greater attention hereafter. It has pointed out that as in the Royal School of Mines, London, greater emphasis should be laid on geology in teaching mining.

The Committee has proposed a scheme of post-graduate training to enable the graduates of the School to pass the competency examinations prescribed under the regulations. This scheme is estimated to cost Rs. 2·63 lakhs per year, a sum which, it is urged, should be shared equally by Government and the Industry.

The need for increased association between the School and the Industry has been emphasised by the Committee who suggest that the mining associations should provide endowments in the School, and also that representatives of the Industry should be associated with its Governing Body in greater strength than at present.

Interim action on the lines of the recommendations of the Reorganisation Committee has been initiated by the Works, Mines and Powers Department (India) sometime ago, and some of the additional accommodation that will be necessary for the School in its expanded phase are already under construction.

A SURVEY OF VARIOUS ELECTRIC SMELTING PROCESSES AND THEIR APPLICATION TO INDIA—PART I

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NATURE has endowed India with an unusually large share of the mineral resources of the world. Iron ore, bauxite and manganese ore are available in practically unlimited quantities. Chrome, tungsten, vanadium, ilmenite and other ores are likewise plentiful, and there are abundant deposits of limestone.

So far, only a limited advantage has been taken of this wealth, but the growing industrialisation of India will undoubtedly call for an increased utilization of its mineral resources.

In this future development, the electric furnace is bound to play an important part, as the majority of ores and minerals are processed exclusively by electro-thermic or electrochemical means. The very favourable possibilities for inexpensive generation of hydroelectric power give India an advantageous position in the field.

Iron and manganese ore may, of course, be smelted in the common blast furnace, but the introduction of the electric smelting process would preserve the Indian coal and charcoal resources. In view of the scarcity of domestic coal supplies in many localities—at least coking coal—this process would be of great national importance. From an economical point of view, the question of blast furnace *versus* electric furnace depends mainly on the relative cost of coal and electric energy.

THE ELECTRIC FURNACE

The electric reduction process is usually carried out in a low-shaft furnace of simple design, the heat required to maintain the smelting temperature being mainly generated by the resistance of the charge to the electric current which flows between the electrodes.

The principle of a typical electric smelting furnace, as used for the production of ferrosilicon, for instance, is shown in Fig. 1. The voltage of the incoming high tension current is stepped down to operating voltage in one or more furnace transformers (*t*), located in the near vicinity of the furnace. From the transformer, the current is carried to the electrode (*e*) through interleaved heavy copper bus bars, copper tubes and cables. Contact with the electrode is ensured by means of water-cooled clamps.

The electrodes were previously of the prebaked type, which frequently had to be renewed at the expense of labour and breaks in production, but in the early twentieth century the Søderberg continuous self-baking electrode came into general use. This electrode, which is illustrated by Fig. 1, is prepared at site and baked by waste furnace heat. In principle it

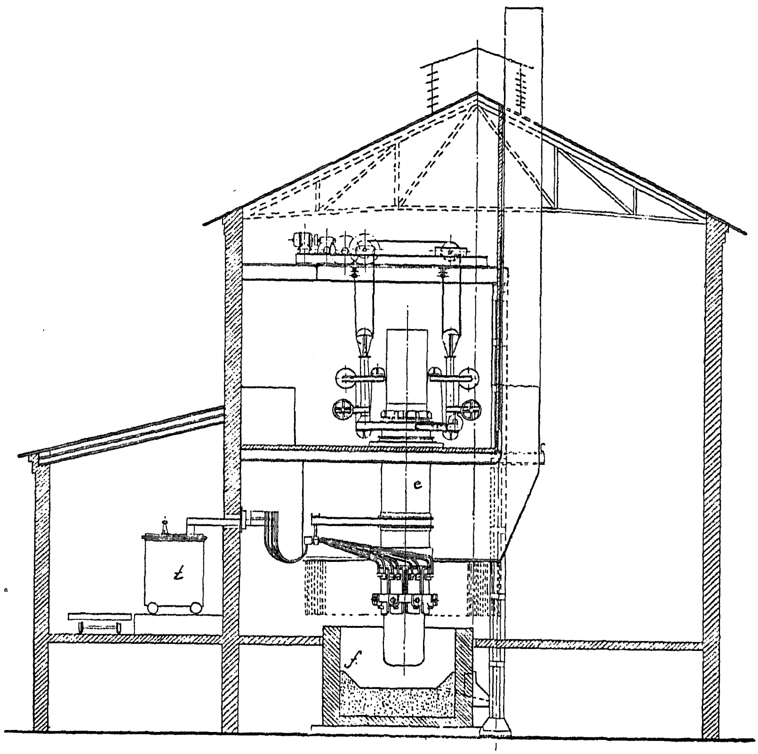

FIG. 1. Section through smelting plant.

consists of a steel sheet casing, filled with electrode paste. As the electrode is consumed in the smelting process the top end is extended by welding on new sections of electrode casing and re-filling paste. This electrode is now widely used in the smelting industry, and has been described in detail in various technical literature.

The furnace body (*f*) consists of a steel shell, lined internally with heat-resisting brick and rammed carbon/tar paste.

The molten product is tapped through one or more tap-holes into tapping pans or ladles, and is crushed after cooling.

The electric smelting furnace may be equipped with up to three electrodes (in special cases even six), but it is now almost unanimously accepted that the three-phase furnace is to be preferred for high loads, *i.e.*, from about 4,000 kW and upwards. In smaller furnaces it may be desired to use one electrode only, for greater simplicity of design and operation. Two such single-phase furnaces may be coupled in Scott to give a uniform load on a three-phase power distribution line.

Owing to the rectangular shape of the prebaked electrodes used, these were originally placed in line, but the more recent practice is to arrange the electrodes in an equilateral triangle in order to obtain electrical symmetry.

Most electric smelting furnaces are of the open type, where the gases burn on the surface of the charge, and are subsequently sucked off through stacks, or in some cases put through a dust removal plant. The open furnace is simple in operation, but the CO gas evolved is, of course, wasted.

Ferrosilicon

Ferrosilicon is an electro-thermic product which is usually smelted in an open furnace, owing to the high temperature required for ore reduction.

The lower grades of FeSi (containing less than 20 per cent. Si) may be produced in blast furnaces from silica-rich iron ores, but all other grades are smelted exclusively in electric furnaces. The process is simple, and consists of the reduction of quartz by coke, anthracite or charcoal. Scrap-iron is used when necessary, to obtain the desired Si-content.

The quartz should be as pure as possible (96-99 per cent. SiO_2) and free from impurities which may cause slag formation or appear in too large quantities in the tapped product. This is, of course, of primary importance when producing silicon metal. There are no special requirements as to the quality of the coke, and even coke breeze is employed to a very large extent.

However, when producing alloys containing 90 per cent. or more silicon, the coke must obviously have a low enough iron content to ensure that the desired metal quality is obtained. In the production of silicon metal it is necessary to use charcoal or petrol coke, in order to limit the iron and alumina content of the charge to a minimum.

Owing to the high melting point of the raw materials used, and in the case of high grade FeSi and also alloy, the primary object in the ferrosilicon furnaces is to obtain the greatest possible concentration of heat in the smelting zone. This may be accomplished by operating with a high current density in the electrodes.

Furnaces for the production of 45-50 per cent. and 75-80 per cent. ferrosilicon are generally built in capacities up to 8-9,000 kVA, whereas for silicon metal, 5,000 kVA may be considered a large unit.

The latest improvement in electric furnace design, the rotating hearth furnace, has found its first application in the production of ferrosilicon. According to this design the furnace body is placed on a turntable which rotates or oscillates at a low speed. The electrodes, suspended vertically at three points of an equilateral triangle, remain stationary. The smelting zone will thus move sideways in relation to the electrodes.

The advantages claimed for this furnace type are that the smelting conditions are improved, as the charge is kept porous by the motion, and the gases may escape freely. "Bridge" formations and explosive gas eruptions, which may sometimes be experienced in a stationary furnace, are reduced. The power and raw material consumption is also stated to be decreased, and wear on hearth and lining is reduced. Furthermore, the furnace pot may easily be cleaned out during shut-downs, or when a change-over from one product to another is contemplated.[1]

Below are tabulated some operational figures for various qualities of ferrosilicon. The better figures refer to modern installations with Søderberg electrodes.

Ferrosilicon Operating Data (per ton tapped ferrosilicon)

FeSi grade	45%	75%	90%	Si metal
Power consumption, kWh ..	5000–6000	9000–11000	12 00–15000	18000–22000
Electrodes, kgs ..	30–40	60–70	100–120	150–180
Coke, kgs ..	550–650	1100–1200	1400–1600	..
Charcoal. kgs ..	..	..	..	2000–2200
Quartz, kgs ..	900–1100	1800–2000	2300–2600	3000–4000
Scrap iron, kgs ..	500–600	200–250	10–30	..
Man hours (furnace operation and tapping only)	10–12	15–20	23–30	40–50
Silicon yield %	90	85	80	60–65

1. Ellefsen, T., "The ELKEM Rotating Hearth Furnace for Electrothermic Process," The Electrochemical Society, 1946.

It should be noted that the figures are based on normal operating conditions, and that they are subject to considerable variations according to quality of raw materials, efficiency of labour and operation, etc.

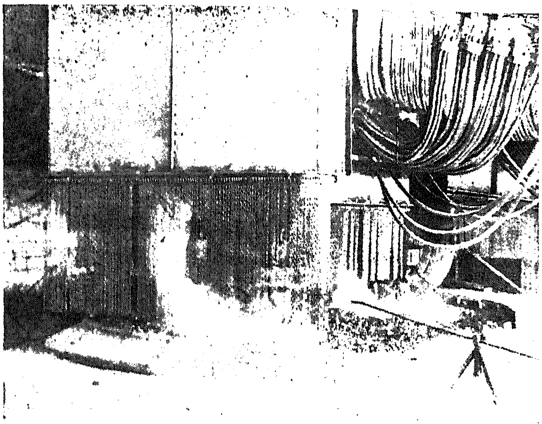

FIG. 2. 15,000 kW carbide furnace.

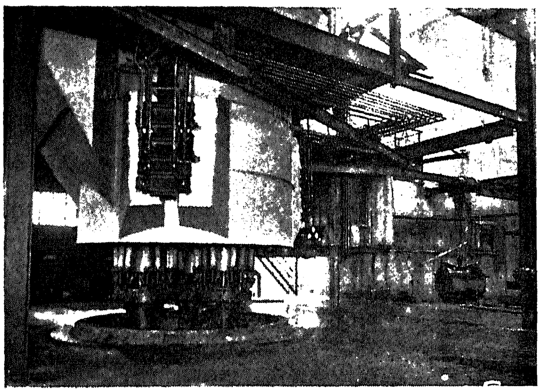

FIG. 3. 10,000 kVA ferro alloy furnace.

CALCIUM CARBIDE

Calcium carbide is prepared exclusively in the electric furnace, lime being reduced by a carbonaceous material under high temperature (2,000-2,200° C.), according to the equation:

$$CaO + 3\,C = CaC_2 + CO.$$

Commercial grade carbide which according to international specification should yield 280-300 litres of acetylene, contains some 80-82 per cent. CaC_2.

The lime should be of the best quality available (96-98 per cent. CaO), and particular attention must be paid to its physical characteristics. The most common reducing agents employed are coke and anthracite. In connection with high grade lime, bituminous coal may also be used in open furnaces. Charcoal is normally too expensive, but is otherwise an excellent reducing agent, which will produce a pure carbide. Charcoal of the heavy tropical type is especially suitable. It is most essential that the raw materials are correctly sized, and too high a moisture content in the reduction materials should be avoided, as otherwise the lime will be slaked after the charge has been mixed.

Carbide is produced in electric furnaces constructed on the same principle as those employed for ferrosilicon, but much larger units have been built in the endeavour to obtain increased production and reduced production costs. The transformer capacities may vary from about 3,000 kVA to as much as 40,000 kVA. The greater number of carbide furnaces in the world are still of the open type but, semi-closed and closed furnaces are also much used. The semi-closed type has found particular application in many of the modern carbide works in Germany.

These furnaces are usually rectangular, with three oblong electrodes connected in line. The electrodes were previously made up of four to six blocks of pre-baked carbon sections, but even before the war they had been to a great extent exchanged for oblong Søderberg electrodes. "Bridges" of water-cooled pipes covered with a heat-resisting material are arranged between the electrodes, and also between the end electrodes and the furnace wall. The purpose of the bridges is to improve working conditions for the furnace operators, and to collect some of the furnace gases which may then be sucked off through a stack, or passed through a gas-cleaning plant.

The gas may contain as much as 55-65 per cent. CO, and some 35-40 per cent of the amount evolved may be collected.

Entirely closed carbide furnaces, equipped with electrodes in triangle, have been in operation in the United States for a number of years. The furnace cover is usually constructed of water-cooled, alloy steel sections. Around each electrode is a hopper, fed with raw material mixture from overhead bins. According to reports, this type of furnace operates very satisfactorily, but it is dependent on a mixture feed containing little or no fines, as the small particles would prevent the passage of gases, and thus cause "blowings".

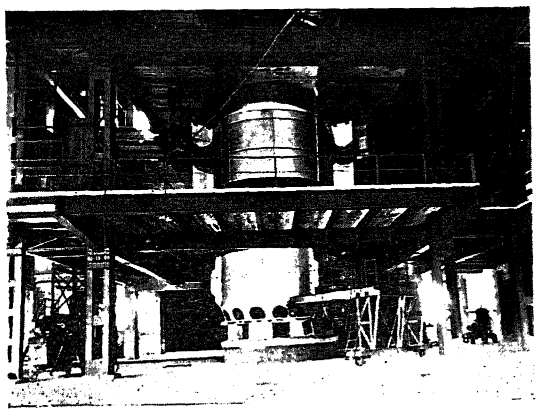

FIG. 4. 6,000 kW rotating hearth furnace.

Closed carbide furnaces as designed by Elektrokemisk A/S, Oslo, Norway, are now also being introduced on the principle of the Tysland-Hole furnace (see next chapter). According to this design the charge is fed to the furnace through water-cooled shafts, located at a distance from the electrodes, the advantage being that the evolved gases are permitted to escape more freely, and operation is far less dependent on the physical qualities of the raw materials.

Closed furnaces are generally more economical in operation than open furnaces, and the working conditions for the furnace crew are greatly improved. The furnace gas is, furthermore, a valuable by-product, and may be used for heating, chemical synthesis or other purposes.

Below is given a table of operating data for carbide furnaces, the better figures relating to large furnaces. Operating conditions and quality of raw materials are assumed to be normal.

Calcium Carbide Operating Data

	(Per ton 300 ltr. carbide)
Lime (96–98% CaO), kgs	900–1000
Coke (10–12% ash), kgs	600–650
Power, kWh ..	2900–3600
Man hours (furnace operation and tapping only)	2–7
Electrodes, kgs ..	10–30

Calcium carbide was previously used almost exclusively for welding and lighting purposes, but an ever-increasing amount is now being absorbed by the chemical industries.

Pig Iron

The electric furnace is also widely used for the production of pig iron. It finds its main application in regions where good quality coke is scarce, and hydro-electric power available at comparatively low cost.

Electric smelting of iron ores was first introduced in the beginning of the twentieth century, with the Swedish "Elektrometall" furnace.

This furnace, which was only designed for the use of charcoal as a reducing agent, has since been superseded by the Tysland-Hole furnace, the first commercially successful electric pig iron furnace also to be adapted to the use of coke.

The Tysland-Hole furnace is a low-shaft, closed electric furnace, which can operate with almost any kind of reduction materials, and which is generally much less dependent on the high physical strength of the raw materials than the blast furnace.

The furnace is equipped with three Sφderberg electrodes, usually arranged in triangle. The furnace arch is built of fire-brick, and rests on water-cooled steel beams. The charging system, by which the raw materials are fed to the furnace at a distance from the electrodes, is of particular interest.

The main advantage of this system is, as mentioned before, that furnace operation is far less sensitive to fines in the charge, than with other closed furnaces.

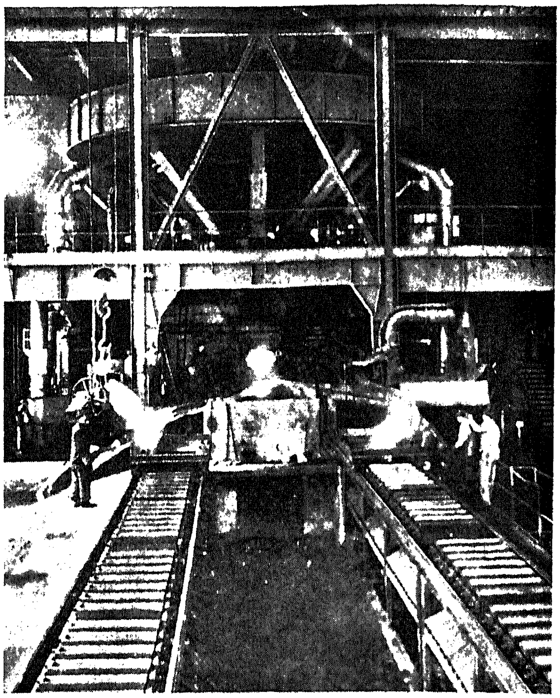

FIG. 5. 7,500 kVA Tysland-Hole furnace.

Owing to the high slag temperature in the electric furnace, exceptionally good desulphurization may be obtained.

The furnace gas is a valuable by-product, which may be used for chemical synthesis, sintering of fine ores, heating or other purposes. Some 650 Nm^3 of gas is produced per ton pig iron, the calorific value being about 2,500 kCal/Nm^3. A typical gas analysis is as follows:

Gas constituent	Volume %
CO_2	15
CO	72
C_mH_n	3
H_2	8
N_2	2

As the gas usually contains a certain amount of dust, it is purified in a gas-cleaning plant before entering the distribution line.

The Tysland-Hole furnace can be operated on 50 per cent. of the normal load, without any disturbances or unreasonable increase in the consumption figures.

The furnace is usually built in two standard sizes, *viz.*, 7,500 and 13,200 kVA capacity, corresponding to a daily output of approximately 50 and 90-100 metric tons of pig iron respectively. A larger unit of 24,000 kVA, with an

estimated daily capacity of 200 tons, has also been designed, and three or four of these units will be erected for the new iron and steel plant which is being built by the Norwegian Government.

Below are tabulated some operational figures for Tysland-Hole furnaces. The figures are based on a burden giving 50-55 per cent. pig iron with a Si-content of 1-2 per cent., under normal operating conditions.

Tysland-Hole Furnace. Operating Data

Transformer capacity kVA	7,500	13,200
Normal operating load, kW	6000-6500	10000-11000
Annual production, M. tons	17000-20000	30000-33000
Labour (entire staff included) man hours per ton		
For one furnace ..	5	3
For two furnaces ..	3·5	2

	Per metric ton of pig iron
Slag produced, kgs ..	350-500
Gas produced, Nm^3 ..	650-700
Ore, kgs ..	1500-1700
Limestone, kgs	300-400
Reducing agent, kgs (coke, coke breeze, anthracite charcoal, etc., 10-15% ash)	375-450
Electric power, kWh ..	2400-2600 (*)
Electrodes, kgs ..	8-15

* Under favourable conditions, the power consumption may be as low as 2200 kWh. If foundry pig iron containing 2-3% Si is produced, the kWh-consumption will increase to about 2600-3000 kWh per metric ton.

Ferromanganese

The most important manganese alloy is standard ferromanganese, containing 78-82 per cent. Mn and 6-8 per cent. C. Other commercial grades are "Spliegeleisen" (15-30 per cent. Mn) and silico manganese, containing approximately 25 per cent. Si, 55-70 per cent. Mn and less than ·5 per cent. C. Low carbon ferromanganese and manganese metal is also produced for special purposes.

Standard ferromanganese may be produced either in the blast furnace, or electrically. Electric furnaces have found application in regions where the cost of power is low, and where coal of a quality suitable for blast furnace use is scarce. The process is simple, comprising the reduction of manganese ore by coke, under high furnace temperature. Limestone is added for slag formation.

In order to obtain satisfactory, economical operation, rich manganese ore should be used 50% Mn), but low grade ores (35-45% Mn) may also be employed, provided the silica content is not excessive (below 10%). In contrast to the blast furnace, electric production of ferromanganese may also be accomplished with inferior quality reduction materials. Coke breeze is a common and inexpensive reducing agent, and charcoal or anthracite may also well be used.

Owing to the fact that manganese is easily volatilized, it is essential to keep the operating temperature as low as possible, in order to reduce evaporation. For this reason, comparatively large electrodes with a low current density are used, and closed furnaces are employed to a certain extent.

The American type furnace, as previously described, is much used, but ferromanganese is now also smelted successfully in the Tysland-Hole furnace. Capacities may vary from 2,000 to 15,000 kVA, the larger units being more economical in operation.

The following table gives various operational figures for ferromanganese furnaces. The figures are based on normal operating conditions.

Ferromanganese Operating Data

Analysis: 78-82% Mn, 6-8% C	(Per ton tapped product)
Power consumption, kWh ..	2500-3500
Manganese ore, kgs (50% Mn, 7% SiO_2) ..	1800-2000
Limestone, kgs ..	450-600
Coke (10-15% ash), kgs ..	550-650
Electrodes, kgs ..	15-25
Man hours (furnace operation and tapping only) ..	4-5
Manganese yield % (approx.) ..	80-90

Ferrochrome

Ferrochromium containing more than 4 per cent. C is produced in the electric furnace without any serious difficulties, through the direct reduction of chrome ore (48-50 per cent. Cr_2O_3) by a carbonaceous agent. Working with a surplus of ore, and using firebrick lining for the furnace instead of carbon, the carbon content may be reduced to approximately 1 per cent., although the chromium yield will thereby decrease.

Low carbon ferrochrome (0·5-0·4% C) used to be produced alumino-thermically. But reduction in the electric furnace by means of a two or three-step process is the accepted modern method. The French Moutiers process for the production of ferro alloys low in carbon, is also used with success in the manufacture of L.C. ferrochrome.

Ferrochrome Operating Data

(Analysis: 4-6% C and 68-72% Cr)	(Per ton FeCr)
Power consumption kWh ..	5000-6000
Ore (50% Cr_2O_3), kgs ..	approx. 2200
Quartz, kgs ..	,, 300
Coke (10-15% ash), kgs ..	,, 600
Electrodes, kgs ..	50-60
Chromium yield, % ..	90-95

The electric furnace is also employed in the production of a number of other ferro alloys, such as ferrotungsten, ferromolubdenum, ferro-

zirconium, etc. These processes are generally carried out on a much smaller scale than those already described, and it should not be necessary to go into details. There is, however, a growing interest in these more "rare" elements, and the future will no doubt also bring improved and rationalized methods of production.

The possibilities for large-scale expansion of the metallurgical industry in India are almost inexhaustible. A good start has already been made by the proposed plans for increased production of iron and steel by the electric process. Carbide and ferro alloy furnaces are also under consideration. Furthermore, projects have been drawn up for several large hydro-electric power plants, and many districts are favourably situated with regard to further harnessing of water power.

The Indian industry should, therefore, be in a position to attain a high standing in the electrometallurgical field.

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AN ACCURATE PRESSURE GAUGE EMPLOYING MEASUREMENT OF SURFACE STRAIN ON DIAPHRAGMS

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THE simplicity and accuracy with which surface stresses can be measured by means of bonded wire strain-gauges prompted us to investigate whether the measurement of surface-strains produced on diaphragms (as distinct from the customary deflexion measurements) could be adapted to accurate measurement of high pressure. The preliminary results obtained in this investigation are set out here and it can be seen from these results that the method proposed is indeed capable of high accuracy.

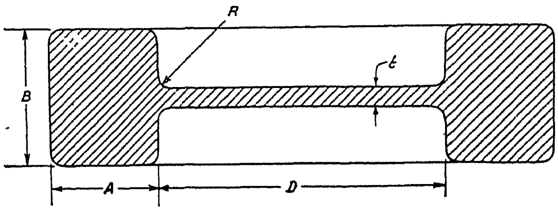

FIG. 1

As plain discs, clamped at the edge, did not yield reproducible results, diaphragms with integral holding-rims and appropriate fillet radii, as shown in Fig. 1, were employed. These were accurately machined out of thick plates of spring steel, clamped at the rim in high pressure unions and work-hardened *in situ* by subjecting them repeatedly to cycles of high and low pressures. The dimensions of the diaphragms employed and their maximum service pressures are given in Table I.

Two well matched strain-gauges (Tinsley's) each of about 200 ohms resistance, were mounted with Durofix, one almost centrally on the diaphragm to measure the strain and the other on the union-nut to compensate for variations in ambient temperature. The variations in the resistance were measured to within 4×10^{-4} ohms with a direct-current bridge of the Callendar-Griffith type, using as null indicator a Moll reflection galvanometer of high sensitivity. With this equipment surface strains could be measured correct to ± 1 micro-inch per inch.

As reference gauge a Budenberg Standard Test gauge with ten-inch dial and reading up to 2,000 lb. per sq. in. was employed. The

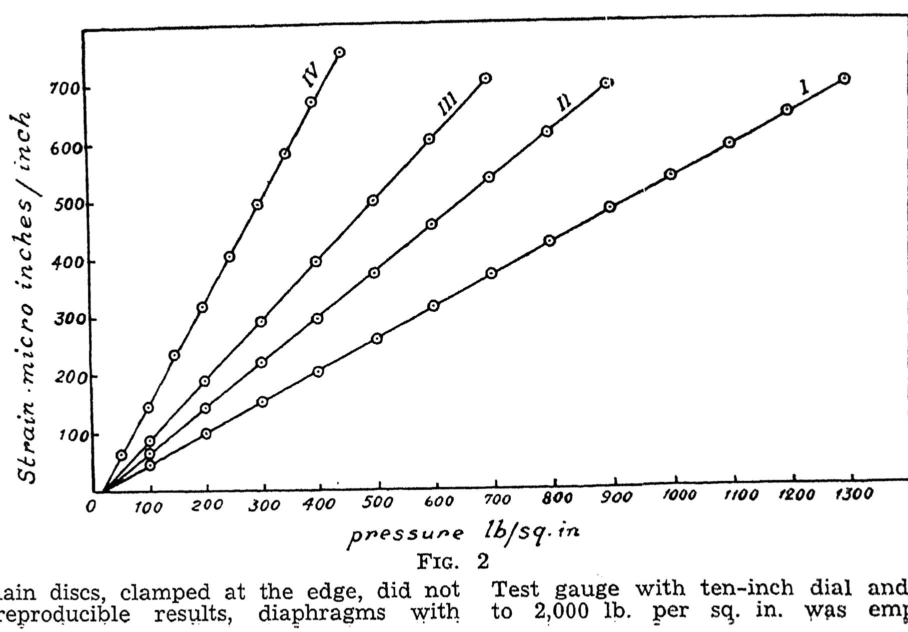

FIG. 2

pointer of this gauge was set by the makers to read the absolute pressures directly on the dial. The gauge calibrations were checked with a dead-weight tester and were found to be correct to ±1 lb. per sq. in. up to 1,500 lb. per sq. in.

TABLE I

Dimensions of the diaphragms and their maximum service pressures

Diaphragm No.	I	II	III	IV
Thickness over flat portion (t in.)	0·0945	0·0735	0·0640	0·0420
Diameter of diaphragm (D in.)	1·250	1·226	1·250	1·25
Fillet radius (R in.)	0·04	0·05	0·06	0·15
Radius of flat portion (D/2 – R)	0·585	0·563	0·565	0·475
Width of rim (A in.)	0·21	0·22	0·21	0·21
Thickness of rim (B in.)	0·20	0·19	0·18	0·25
Maximum Service Pressure (lb./sq. in.)	1300	900	700	450

The results obtained are shown graphically in Fig. 2. In each case, the plot of strain *vs.* pressure gave a straight line. Within the limits of maximum service pressures given in Table I, the diaphragms were perfectly elastic and responded to rising and falling pressures without lag and without hysteresis or creep. The pressure *vs.* strain calibrations were remarkably stable and the slope of strain to pressure was maintained even after the diaphragms had been dismantled and reassembled.

Table II shows a typical set of data obtained in four calibrations with Diaphragm III, on which a strain-increase of 1μ in./in. corresponds nearly to an increase 1 lb./sq. in. in the pressure. It is evident from the table that the largest average deviation from the mean values is 1·25; *i.e.*, 1/6 per cent. of the full range value of 706 μ in./in. Even towards the lower end of the scale (*e.g.*, 100 lb./sq. in.) the average error is less than ½ per cent. of the mean value for that pressure, but less than 1/11 per cent. of the full-scale value.

TABLE II

Results obtained with diaphragm III in four runs

Pressure lb./sq. in.	Strain in μ in./in.					Average deviation from the mean	Percentage of Av. Devn. / Av. strain
	1	2	3	4	Mean		
13·4	0	0	0	0	0	..	..
100	86	86	85	86	85·7	0·4	0·46
200	189	189	187·5	187·5	188·3	0·7	0·37
300	291	290	290	290	290·3	0·4	0·14
400	394	395	394	395	394·5	0·5	0·13
500	499	499	496·5	496·5	497·8	1·25	0·25
600	601·5	603	600·5	601·5	601·6	0·68	0·11
700	706	706	706	706	706	0·00	0·00

Apart from the accuracy, the method suggested above carries with it, all the advantages common to electrical methods, such as adaptability for remote control, wide choice of accessory apparatus, interchangeability of components, etc.

The variation of strain with pressure is being further examined.

Our sincere thanks are due to Prof. B. C. Carter, Head of the Department of Internal Combustion Engineering, for many helpful suggestions.

METALLOGENETIC EPOCHS IN INDIA

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CERTAIN relations between the formation of ore-deposits and other geological processes are now generally accepted, namely, that many metal deposits are closely associated with igneous activity, that igneous activity occurs in belts of strong folding and faulting in orogenic belts, and that ore depositions have been repeated through geological time resulting in rather definite periods in which metalliferous deposits have formed. These periods of metal deposition are known as metallogenetic epochs.

In Europe, four systems of folding or orogenic periods have been recognized, namely, Huronian (or Charnian), Caledonian, Hercynian and Alpine. Most of the metal deposits there result from igneous activity related to these periods of folding and faulting.

The Huronian movement is mainly confined to the great shield of Fenno-Scandia, to Sweden, Norway and Finland. The deposits carry mainly iron and copper. The rich magnetite deposit at Kirunavaara associated with a syenite porphyry is believed to be of this age.

The lead and zinc lodes of Leadhills and Wanlockhead in Scotland are attributed to the Caledonian folding as also the ores of copper, nickel, titanium and chromium of northern Norway connected with gabbros in the Cambrian-Silurian complex.

The Hercynian movement came between the Carboniferous and the Trias and resulted in great mountain chains extending east and west across Europe. In England, this is known as the Pennine-Armorican movement; and the formerly copper but now tin, and the lead and zinc lodes of Devon and Cornwall are genetically connected with the west-of-England granites. Although their direct association with any intrusive body is not obvious, the lead and zinc lodes in the Carboniferous limestone of the Pennine range at intervals from Derbyshire to Northumberland are connected with the Pennine folding.

In the continent, the Linares field, once the most prolific lead mines in the world, and the equally famous Rio-Tinto and Tharsis mines in Spain, the classical lead and zinc veins of Clausthal in the Hartz mountain, the Erzgebirge field, the tin fields at Zinnwald in Germany are all connected with granites and with the Hercynian movement. The Altaid mineral deposits of the Urals and the poly-metallio lodes of Balkash in Eastern Russia, and along the Russo-Afghan border all belong to this period.

With the ridging up of the Alps, southern Europe became the scene of great activity in connection with igneous outburst. The lead and zinc deposits of Raibl in Italy, Bleiberg in Austria and Mesieza in Yugoslavia are connected with the great Alpine intrusions of granitic rocks. The Eocene intrusions of peridotite, gabbro, etc., gave rise to the magmatic chromite deposits in Greece and Asia Minor. The metal mercury is especially associated with this movement; the Spanish Almaden mines and the Idria mine in Italy are of this period.

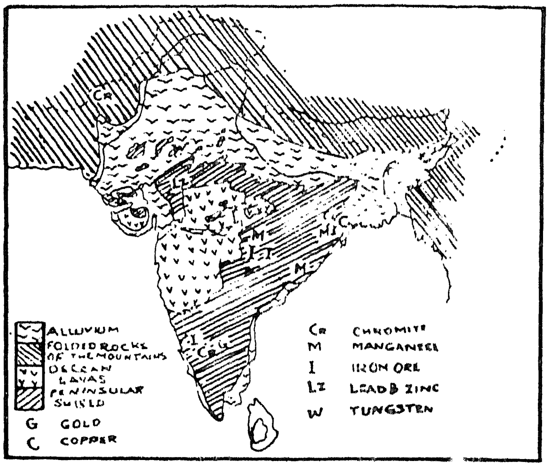
In the United States of America, taking the Cordilleran region alone, which is one of the great mineral store-houses of the world, we find that here three distinct metallogenetic epochs are recognized, *viz.*, pre-Cambrian, post-Jurassic and late Cretaceous—Tertiary the last two of which are clearly related to periods of mountain-building. The Sierra Nevada and the Coast Range are post-Jurassic in age and the mineral deposits that occur here are genetically related to the Sierra Nevada and the Coast Range granodiorite batholiths. The metals worked are gold, copper, lead and zinc.

The Rocky mountains were ridged up from late Cretaceous to Tertiary, and the mineral deposits around the Columbia and Colorado plateaux are connected with igneous activity that took place about this time. The metals mined are silver, gold, lead and zinc (not conspicuous), tellurium, antimony and quicksilver.

In Asia, pre-Cambrian deposits are represented by gold-bearing veins in the great shield extending on both sides of Lake Baikal and in Korea, and in the Indian Peninsular Shield. Deposits of Hercynian or late Palæozoic age are found in many ranges in Central Asia, such as the Urals, the Altai and the Trans-Baikalian mountains. Gold, lead, silver and other metals are found here in well-defined veins. To the same age are referred the tin and wolfram deposits of Malaya, Burma, Siam and China.

In southern China at least five orogenic periods have been recognised, *viz.*, Caledonian, Hercynian, Anyuanian (late Triassic), Yenshanian (phase A in late Jurassic, phase B between Cretaceous and Eocene) and Nanlingian (middle Tertiary). Of the three metallogenetic periods in China, namely, (1) Pre-Cambrian, (2) Hercynian and (3) Tertiary, the first is connected with deposits of gold, tungsten and molybdenum the next with tin, zinc and antimony, and the third with mercury: all genetically related to granitic intrusions.

In India, the two generally accepted orogenic movements are the pre-Cambrian, which ridged up the Aravalli mountains and the Himalayan in Tertiary time. Recently, however, Prof. Pichamuthu has been able to decipher two more orogenic periods in the Dharwars of South India.



From a study of the metal deposits of India and Burma five metallogenetic epochs can be pretty well recognized, namely, pre-Cambrian, Malani (pre-Vindhyan), Caledonian, Hercynian and Cretaceous.

As producers of economic deposits, however, the pre-Cambrian is the most important epoch in India, while in Burma, both the Caledonian and the Hercynian are of great importance.

Covering nearly one-third of India's sixteen lacs square miles, the Peninsular Shield contains nearly all her metal deposits including the most important ones, *viz.*, gold, copper, chromite, iron and manganese (the last two being sedimentary).

In the Dharwars of South India occur the gold-bearing quartz-veins related to the granitic constituents of the Champanir gneiss. Belonging to the iron-ore series are the Singhbhum copper deposits related to a Soda granite. The Khetri copper deposit is in Aravalli slates.

The Mysore, Madras, Keonjhar and Singhbhum chromite deposits are genetically connected with the ultra-basic rocks in which they occur.

It is, however, too early to say to which of the two Dharwarian orogenic movements these several metal deposits owe their origin.

The wolfram deposit of Degana in Jodhpur State and the Jawar lead and zinc deposit in Udaipur State are intimately connected with the Jalore and Siwana granites of Malani age.

Related to the Tawnpeng granite the Bawdwin lead, zinc and silver deposits have been assigned a Cambrian age (not with great certainty), and possibly owe their origin to some movement corresponding to the Caledonian in Europe. The Mawson lead deposits also belong to this period.

To the Hercynian we owe the tin and wolfram deposits of Burma, the zinc deposit of Riasi in Kashmir, and the orpiment deposit of Chitral.

Closely connected with the late Cretaceous movement, well recognized in Burma, are the chromite deposits of the Arakan range and of Pishin-Zhob in Baluchistan.

The following table gives an idea of the repetition of metal deposition through geological time.

Period	Europe	North America	Asia	India and Burma
Pre-Cambrian ..	Iron, Copper	Gold, copper, nickel, silver	Gold	Gold, copper, chromium
Malani ..	..	..	..	Tungsten, lead, zinc
Caledonian ..	Lead, zinc, copper, nickel, titanium, chromium	Gold	..	Lead, zinc, silver, nickel
Hercynian ..	Copper, tin, lead, zinc	..	Gold, lead, silver, zinc, antimony	Zinc, tin, tungsten, arsenic
Cretaceous ..	..	..	Gold, copper, lead, zinc, silver	Chromium
Tertiary ..	Lead, zinc, chromium mercury	Gold, silver, copper lead, zinc, arsenic, antimony, mercury	Gold, copper, antimony, mercury	..

OCCASIONAL DISTANT WEATHER INFORMATION AND FORECASTING

S. L. MALURKAR

(*Poona* 5)

A WEATHER forecaster depends entirely on the amount of meteorological observation that he has at the time of issuing forecasts. It often happens that at certain places, the amount of weather information is limited due to communication difficulties. During the period of war, much of the needed weather information is absent. The forecaster has to strain to deduce more results with the little information he has. The method of deducing the results here, follow from the book *Forecasting Weather In and Near India*.[1]

If a broadcast or news item gives an account of extensive damage due to weather in the tropics, away from the equator, it is most likely that a cyclonic storm or typhoon would have been responsible for the damage. If, in the equatorial regions, heavy rain is reported in the absence of cyclonic storms, it shows the passage of 'pulses' of maritime air which may later in their travel cross to the north of the equator from the south or *vice versa* and become the respective equatorial maritime airs. If in higher latitudes (20° to 25° N) damage or bad weather is reported in terms of dust or thunderstorms, the passage of an extra-tropical disturbance can be inferred. Even in the Sahara region, some Geographical Expeditions have mentioned of sudden showers and later clearing up, which can only be assigned to passing extra-tropical disturbances.

In news items of the daily papers or radio-broadcasts, mention is generally made of the more destructive typhoons in the China Seas. Sometimes, the item of news may be merely the delaying of the sailing of steamers due to bad weather or the extensive damage to coastal towns or even to seacraft. In all these cases, it is possibly due to the presence of a typhoon in the China Seas. If the report of the typhoon is not too far north of the equator, one can assume that a secondary effect of the typhoon would influence the Indian weather. The idea of excluding typhoons too far north of the equator is to prevent the tropical cyclonic storms and extra-tropical depressions from getting mixed up.

In tropical cyclonic storms, three air masses are involved: (1) Em, the equatorial maritime air which crosses at intervals, under favourable conditions, the equator from the other hemisphere, (2) Tr, a mixed or transitional air containing a mixture of the tropical maritime and tropical continental air in varying proportions and whose ultimate origin should be the north Pacific high and the north Asiatic high, and (3) Tc, the dry continental air, being a mixture of tropical continental air and a small amount of Polar continental air. The first air mass, which has come from the other side of the equator is a bigger determinant of the tropical cyclonic storm than the other two air masses which are available on the same side of the equator as in the tropical cyclonic storm. The presence or existence of these latter two air masses can be assumed as a rule. As Em crosses the equator, not daily, but only at intervals when other conditions are favourable, it can be concluded that the existence of the tropical cyclonic storm, by itself, is an evidence of the favourable conditions for the passage of Em across the equator. The actual conditions have been set out in the book.[2] The Em must have crossed as a 'pulse' from the other side of the equator due to the interposition of a high wedge or ridge across its path and with favourable conditions north of the equator (in case of the northern hemisphere). If the 'pulse' had to cross to the north of the equator due to the interposition of the high ridge, to the west of the ridge a secondary 'pulse' would start in its mainly westward motion to produce the Em of more westerly longitudes. It may cross to the north

of the equator if another high pressure ridge came across its path with favourable conditions in the north. The cycle of successive secondaries continues in the tropical belt round the equator. If the secondary 'pulse' of equatorial maritime air crosses into the Indian area, unsettled conditions would be produced there and if the feed of the other two air masses is possible, a depression or a cyclonic storm forms in the north Indian Ocean. A knowledge of the China Sea typhoon is a fore-warner of the possible unsettled conditions or a depression in the Indian area. As regards the time interval that one has to expect before the 'pulse' crossed into the Indian area from the time the original or primary 'pulse' crossed into the China Seas to give the typhoon there, the general experience of the weather forecaster comes in handy. It is a well-known fact that though a depression is forming in the Bay of Bengal, conditions get unsettled almost simultaneously in the S.E. Arabian Sea. Though the number of observations are few in the South Indian Ocean, it is found that almost at the same time a 'pulse' is crossing into the northern hemisphere, a secondary 'pulse' is almost readily formed and moving in its westerly history. The crossing of the original 'pulse' of Em to the China Seas can almost be "ignored" as though the original 'pulse' travelled only westwards and reached the Indian longitudes. The information of the typhoon is merely used for the knowledge that fresh air is moving south of the equator. To put it in other words, the 'pulses' move with a sort of "group" velocity forming secondaries successively after each crossing to the north. The approximate rate of travel of the fresh air masses south of the equator has been mentioned to be between 300 and 500 miles a day.[3]

If the information is from the equatorial latitudes, where cyclonic storms are rare, *e.g.*, a mention of heavy rain at Singapore or in Java, it would indicate that fresh maritime air is passing over the place. A 'pulse' of fresh maritime air may be moving from the east, south of the equator, which may later cross into the Indian longitudes and produce successively in the Bay of Bengal and the Arabian Sea unsettled conditions and sometimes depressions. Alternatively, the heavy rain in S.E. Asia may be due to the motion of a fresh air mass from the north to the south to feed a southern tropical depression. A forecaster would be able to distinguish whether the heavy rain is due to a 'pulse' moving south of the equator westwards or due to an incursion of fresh air from north of the equator.

Next there may be information about a hurricane or a typhoon in the southwest Pacific Ocean, in the southern hemisphere away from the equator. If the hurricane is too far south, it need not be considered here. However, if a hurricane or a typhoon was crossing over north Australia, the forecaster has to be on the look out. The presence of the typhoon, hurricane or cyclonic storm south of the equator would result in a stimulation of air from the east. The hurricane may move straight west or west-southwest to the Indian longitudes in the South Indian Ocean. If the hurricane recurved to West Australian coast, it may create a secondary north of it (nearer the equator), which may move westwards into the South Indian Ocean and be for all purposes as effective as if the original hurricane moved dead west. The passage of 'pulses' south of the equator to form or feed a depression, later, in the northern hemisphere produces heavy weather in the regions south of the equator,[4] or a tropical depression in the northern hemisphere is associated with unsettled weather in the southern hemisphere in the neighbourhood of the equator a few days previously. Similarly the passage of a tropical depression south of the equator, when not too far south, in South Indian Ocean would draw fresh 'pulses' from the northern hemisphere and give rise to unsettled weather in the Bay of Bengal and the Arabian Sea successively. Hence with a knowledge of a hurricane in North Australia, the forecaster in India would be on the look out for unsettled conditions in his own area after a definite interval of time. Due to successive incursions of air from one side of the equator to the other and interplays of the other air masses, the unsettled conditions in the North Indian Ocean (produced by the southern tropical depression or cyclonic storm) may give rise to an independent circulation, *i.e.*, a secondary of the southern depression may be formed in the northern hemisphere.[5] The secondary of a tropical depression formed on the other side of the equator, has the tendency to weaken the primary tropical depression and in turn weaken itself.[5] The co-existence of the two tropical cyclonic storms on two sides of the equator is not possible (*i.e.*, with all the three air masses). Hence if the southern depression shows no sign of weakening, it can be assumed that the northern secondary would not be well formed. When the southern depression has moved to a southern latitude too far—when there is a tendency to recurve into an extra-tropical depression with only two air masses—or when the southern depression has moved too far west of the northern secondary, the depression in the Indian area has a chance of developing fully. Otherwise, the northern low pressure areas act as 'pulses' feeding into the southern depression. Due to extensive land masses in the northern hemisphere, the northern 'pulses' or low pressure areas are not as clear as their southern counterparts. However, due to the passage of an extra-tropical depression in more northerly latitudes, the northern secondary, which is ill-developed, may recurve or move in an easterly direction as a secondary of the western disturbance[6] or extra-tropical depression, and may cause bad weather. Even then, the effect of the recurved northern depression remains small unless and until the southern depression has moved too far west or too far south of the northern depression;[7] the forecaster would give less weather than the observations from the north of the equator would by themselves warrant. These ideas have been used for the last few years with success. On December 2nd 1946, Melbourne broadcast the news about the loss of a ship during the previous week-end (probably 30th November) in Torres Straits (between New Guinea and Australia), due to

a hurricane which was the severest since 1922. The hurricane, itself, travelled almost west (or perhaps induced an equally severe secondary) into the South Indian Ocean and continued strong. The series of low pressure areas induced in the Bay of Bengal remained ill-defined for more than a week, until a depression that moved north-east formed. But the resulting weather during the week was responsible for dislocation of normal transport in Madras Presidency.

It is necessary to stress the fact that for tropical weather, *i.e.*, the cyclonic storms and the S.W. monsoon, the weather to the east of India has to be known. Though the main high pressure area which gives rise to the 'pulses' is the South American high pressure area, the travel is from east to west in the narrow corridor of pressure between the high pressure areas in the Pacific Ocean.

But for the weather in winter in India, one has to follow the extra-tropical depressions. The meteorological observations that one can get even during peace-time from Egypt to the frontiers of India are very limited due to deserts and uninhabited tracts or meteorologically unrepresented countries. The wide areas happen to be the regions where the secondaries of western disturbances or extra-tropical depressions form. Many of these secondaries have to be inferred after they have produced weather. Hence there is a need to know about them much earlier. The damage that occurs due to these western disturbances do not have much news value. It is only occasionally that the damage is great enough to be advertised. If such an event occurs either in Egypt or Palestine, it can be assumed that an active extra-tropical disturbance is passing over the countries. These active extra-tropical disturbances would develop secondaries.[7] One or the other of the secondaries would affect India. In the absence of a depression south of the equator moving westwards, the forecaster can anticipate the formation of an active secondary of the extra-tropical disturbance and be forewarned. During the last days of March 1944, a very active extra-tropical depression moved across Egypt and Palestine and caused considerable dislocation. The disturbance which had been detected by the interference in the reception from Ankara[8] could be better evaluated after the receipt of the above information and the forecasts on 1st April, and subsequently could be made more informative. The weather in upper India in the first few days of April 1944 resembled a good rainy day during the monsoons. A southern depression appeared (south of the equator) about the 4th April in the longitudes 90° to 100° moving westwards. The weather over upper India rapidly cleared up after 6th April.

If attempts are made to catch the weather summaries of various meteorological offices, and the weather information that form the "news items", a better appreciation of weather over a larger area can be got, and it would enhance the value of one's forecasts.

The above speculations also lead to the conclusion that a criterion *can be given* strictly separating tropical weather from non-tropical weather. The tropical weather has essentially an eastern origin and travels westwards, while the non-tropical weather has a western origin and moves eastwards. Due to interaction of the various weather situations, *e.g.*, the recurvature of a tropical cyclonic storm under the influence of an extra-tropical disturbance or the greater activity of a western disturbance due to an infeed of N.E. Trades, in any season, one has to watch for signs of weather from both the east and the west.

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1 Malurkar, *Forecasting Weather In and Near India*, 1945 (Private circulation). 2. —, *Ibid.*, p. 34 and p. 87, 3. —, *Ibid.*, p. 119. 4. —, *Ibid.*, p. 24 and p. 64. 5. —. *Ibid.*, p. 96, *et seq.* 6. —, *Curr. Sci.*, 1941, **16**, 14. 7. —, *Ibid.*, p. 139. 8. —, *Proc. Nat. Acad. Sc.*, (Allahabad), 1944, **A, 14,** 131.

OBITUARY

PROFESSOR GEORGE MATTHAI, M.A., Sc.D. (Cantab.), F.L.S., F.R.S.E., F.N.I.

THE sudden death at Cambridge of the distinguished zoologist, DR. GEORGE MATTHAI, Emeritus Professor of the Punjab University, has deprived the science of Zoology of one of its most ardent votaries and his friends and pupils of a lovable personality and inspiring teacher. At a time when this country needs all its ablest men to help in the great task of developing its scientific resources the loss of a scientist of his calibre leaves a gap that will be difficult to fill.

George Matthai belonged to a cultured and gifted family of Syrian Christians from Travancore, his father having later migrated to Calicut. Born at Palghat in Malabar about 59 years ago, he received his early education at the Zamorin's College, Calicut, and later at the Christian College, Madras. Here he graduated, and for about a year served as a lecturer in zoology before he left India for a career of research at Cambridge.

It was at Cambridge, where so many students from distant parts of India are thrown together, that the writer first met George Matthai. We joined Emmanuel College in the October term of 1911 and our association there of about seven years matured into an abiding friendship. Matthai, with already a Master's degree from Madras, and some experience as a College lecturer, was admitted at once as a research student (under Stanley Gardiner), and we juniors, who had yet to go through the mill of the Tripos, at first looked up to him with some degree of deference. Thirty-six years ago it was unusual, not to say rare, to find an Indian student at Cambridge pursuing scientific research, and Matthai was justly aware of a certain glamour that surrounded him. As the years went by we saw him build up an international reputation by his original work, and he inspired us with his example,

Within a couple of years he had made a name for his researches on the morphology and classification of the Madreporarian Corals. The special merit of this work was that it took into account the structure of the soft parts of the body, which were expected to provide a more rational index to affinities than the calcareous skeleton alone. Obviously, the most natural classification would be one erected on the combined basis of the soft parts and the calcareous skeleton. And it would be particularly interesting if a correlation could be established between the structure of the soft parts and the hard, for in that case the perplexing variety of skeletal forms which are grouped in an artificial taxonomy, including all the fossil types of which the soft parts can never be found, could be assigned to their natural places in the evolution of the group.

Matthai's comprehensive and painstaking work thus had very substantial value. Already in 1914 his first monograph on the Astræidæ appeared in the *Transactions of the Linnean Society of London.* The completion of the second was delayed until after the War of 1914-18; meanwhile he had to leave Cambridge to take up an appointment at Lahore. The second monograph was completed during a period of leave in England, and was published as a *British Museum Catalogue* in 1928. Meanwhile he had revised the Madreporarian Corals in the collections of the Indian Museum in Calcutta (*Rec. Ind. Mus.*, 1924); and in 1926 had appeared his important work on the histology and modes of budding in corals as determining the farms of the colonies. This was published in the *Philosophical Transactions of the Royal Society.* In 1940 he discussed the theoretical bearings of his work, summarising his conclusions regarding evolutionary tendencies in the Astræidæ. Latterly he was engaged in the study of the colonial Fungidæ.

Matthai travelled widely in search of his material, undertaking several cruises, *e.g.*, along the coast of Florida, in the West Indies, and in the Indian Ocean. For his taxonomic work he examined all existing type collections in Europe and America. His studies on corals thus formed the main theme of his work, and they are regarded by competent authorities as a monumental contribution to our knowledge of the Madreporaria.

While he was still a young student at Cambridge the importance of the researches in which he was engaged was recognised by the award to him of the Mackinnon Studentship of the Royal Society, and of generous research grants from Emmanuel College and other sources.

In 1918 he was appointed professor of zoology at the Government College, Lahore. There he soon made his mark as a teacher. As Dean of University Studies he did much to stimulate zoological research in the Punjab. At semi-popular lectures he impressed one by his mastery of style as much as by his discrimination in presenting facts. The result was a delightful clarity of exposition.

Two years later we were again brought together for a year at Lahore, where we saw a good deal of each other during the academic session of 1920-21. In January 1923 he came to Lucknow to preside over the section of Zoology at the Tenth Indian Science Congress.

While on leave in England in 1925, he married Mary Chandy, second daughter of the late Mr. C. Chandy of the Mysore Civil Service and later a Vice-Chancellor of the University of Mysore. They had one son, Ariel, an only child, who survives him.

In 1929 Matthai's published work, now voluminous and impressive, was rewarded by the University of Cambridge with the conferment of the degree of Sc.D., the highest degree which that University can bestow upon a man of Science. He was one of the Foundation Fellows of the National Institute of Sciences of India, a Fellow of the National Academy of Sciences, of the Linnean Society of London and of the Royal Society of Edinburgh. In January 1931 we met again at the Nagpur Session of the Indian Science Congress—an occasion marred by the news we there received of the death of Mrs. Matthai.

In 1938, when the Silver Jubilee of the Indian Science Congress was celebrated at Calcutta in a joint session with the British Association, Matthai again presided over the section of Zoology. In both his presidential addresses to the Congress the main theme was research in oceanography and the marine faunas, particularly those of the Indian Ocean, a subject in which he was always at home. He retired from the chair at Lahore in 1943, on reaching the age of 55, but continued his research activity. For some time in 1946 he acted as Director of the Zoological Research Laboratory at the University of Madras.

In his scientific work Matthai was essentially a man of facts, rather than theories: inquisitive by nature, orderly and correct to the limit of punctiliousness. His strict attitude to the observed facts of Science, and his deeply religious temperament were two aspects of the same personality. While always mindful of the rights of others he knew how to assert his own, and to hold his head high. He never grudged any help that he could render to others with his knowledge or advice.

Towards the end of June last year, when I happened to spend a week again at Cambridge, it was a pleasant surprise to know that he was also living at the College. Chatting away into the small hours of the morning we lived the old Cambridge days once again in the familiar scenes of our 'undergrad' years: several of our contemporaries are now dons at Emmanuel and other Colleges. We said Good-bye on the 29th of June 1946—it was to be for the last time. On the 25th June 1947, weighed down by prolonged anxieties, he suddenly took leave of this world, to the grief of all who knew him. He will be missed by his many friends for his frank and lively expression as he greeted them with his vigorous handshake.

(For some of the personal facts relating to the early life of Dr. George Matthai I am indebted to his nephew, Dr. K. Jacob, of the Geological Survey of India, and to Dr. N. K. Panikkar of Madras.)

B. Sahni.

LETTERS TO THE EDITOR

PHOTOCHEMICAL AFTER-EFFECT IN THE DECOMPOSITION OF HYDROGEN PEROXIDE BY POTASSIUM FERROCYANIDE

It has been shown that the photochemical after-effect in the decomposition of hydrogen peroxide by pre-illuminated ferrocyanide can be reproduced in the dark by adding small quantities of the aquo-salt (II), sodium aquopentacyanofertile, to the unilluminated H_2O_2-$K_4Fe(CN)_6$ mixture.[1] Sodium aquopentacyanoferrate, the violet aquo-salt (III), can also be used with similar results. These observations support the view that potassium aquopentacyanoferrite produced photochemically and reversibly in the illuminated solutions of potassium ferrocyanide brings about the photochemical after-effect.

The above view has been tested in another way. It is known[2] that sodium aquopentacyanoferrite reacts with sodium nitrite and nitrosobenzene forming quaternary nitroprusside and a purple-coloured substitution compound respectively:—

$$Fe(CN)_5H_2O''' + NO_2' \rightarrow Fe(CN)_5NO_2'''' + H_2O \quad (1)$$

$$Fe(CN)_5H_2O''' + C_6H_5NO \rightarrow Fe(CN)_5C_6H_5NO''' + H_2O \quad (2)$$

It folows that if the aquo-salt formed from ferrocyanide by insolation causes the photochemical after-effect, the addition of nitrite and nitrosobenzene should considerably reduce or "quench" the after-effect, as the decomposition of hydrogen peroxide by nitrosoprusside formed in (1) is very slow in the dark,[3] and the purple substitution compound formed in (2) is also not very reactive towards hydrogen peroxide.

Potassium ferrocyanide solution (M/64), 10 c.c., was pre-illuminated by direct sunlight for one minute, and added to hydrogen peroxide immediately after darkening, or it was first mixed with aqueous nitrosobenzene or nitrite just after illumination, and then added to hydrogen peroxide in the dark. The concentrations of hydrogen peroxide and ferrocyanide in 50 c.c. of the reaction mixture were N/6 and M/320 respectively. A saturated solution (5 c.c.) of freshly prepared nitrosobenzene in conductivity water was used. Temperature of the reaction was 40° C. The velocity constant has been calculated according to the Unimolecular formula, $K = 1/t \log a/a - x$ where t represents time in minutes, a the initial concentration of H_2O_2 in terms of c.c. of permanganate, and x the change in time t.

Table 1

Without nitrite or nitrosobenzene

t	$a - x$	$K \cdot 10^4$
0	16·10	..
12·5	13·80	54
26	11·40	58
37	9·80	58
57	7·50	58

TABLE 2

With 5 c.c. aqueous nitrosobenzene

t	$a-x$	$K \cdot 10^4$
0	16·25	..
15	14·60	31
34	12·80	31
65	10·00	32
100	8·00	31

TABLE 3

With 0·0020 gm. sodium nitrite

t	$a-x$	$K \cdot 10^4$
0	13·60	..
15	12·95	14
34	12·40	12
68	12·00	8
120	11·30	7

The slightly higher value of $K.10^4$ (54-58) in Table 1 (*cf. Curr. Sci.*, April 1947, p. 118) is probably due to a small change in the intensity of sunlight.

It is seen from Table 2 that nitrosobenzene reduces the photochemical after-effect to a considerable extent, while the nitrite is still more effective in suppressing the after-effect.

A mixture of potassium ferrocyanide and potassium cyanide pre-illuminated and then added to hydrogen peroxide in the dark does not show any after-effect. This is to be expected if the photo-formation of the aquo-salt from ferrocyanide is responsible for the after-reaction. In the presence of added cyanide, the equilibrium

$$K_4Fe(CN)_6 + H_2O \underset{\text{Dark}}{\overset{\text{Light}}{\rightleftharpoons}} K_3Fe\ CN)_5H_2O + KCN$$

is shifted to the left, resulting in practically complete suppression of the concentration of the aquo-salt, so that none exists in such an illuminated solution to produce the after-effect.

It has been further established that the after-effect reproduced in the dark by the addition of minute quantities of the aquo-salt (II) to H_2O_2-$K_4Fe(CN)_6$ mixture is also completely suppressed by CN′ and NO_2', while the diminution brought about by nitrosobenzene is of the same order as already reported in the case of the photochemical after-effect. Pre-illuminated ferrocyanide on treatment with suitable quantities of nitrite or cyanide ions does not answer the tests for the aquo-salt (II), and the pure aquo-salt (II) in the presence of these ions is completely converted into nitroprusside and ferrocyanide respectively.

The photochemical after-effect cannot be ascribed either to alkali or to ferricyanide produced in the course of the reaction, as the experiments with unilluminated ferrocyanide and ferricyanide and alkali failed to show the rapid decomposition characteristic of the illuminated ferrocyanide, which is known to contain minute quantities of the aquo-salt (II). In this connection attention is drawn to an earlier paper by Lal and Singhal[4] in which the decomposition of hydrogen peroxide by ferricyanide has been discussed.

It has already been reported that aqueous solutions of aquopentacyanoferrite exhibit a slow spontaneous decomposition in the dark at room temperature in the presence of air, and the aquo-salt is completely decomposed into ferric hydroxide, ferri- and ferrocyanide. These changes are greatly accelerated by light and heat, and this appears to be the cause of the photosensitivity of the aquopentacyanoferrite ion.[5] These observations are in general agreement with those of Iimori.[6] It is significant to note that the sodium aquo-salt after being heated to about 90° C. for a few minutes or exposed to direct sunlight for about an hour does not give the characteristic colour reactions with *p*-nitrosodimethylaniline or nitrosobenzene.[7] An aqueous solution of the sodium aquo-salt kept in the dark for a few days shows the same behaviour.

Recently, Williams[8] has studied the causes of discolouration of ferro- and ferri-cyanide crystals and has come to the conclusion that the decomposition of the aquo-salt (II) takes place spontaneously in the dark in the presence of air with the formation of ferric hydroxide and ferricyanide. In view of these results, the suggestion of Baudisch[9] that prolonged insolation of ferrocyanide in the presence of air results in the formation of an oxygen-richer product which gives a blue colouration with tincture of guaiacum appears to be untenable. Rather, one should expect this guaiacum colour reaction as indicative of the decomposition of the photochemically produced aquo-salt (II) into ferricyanide, which is known to produce a blue colouration with tincture of guaiacum.

Attention may also be drawn to the author's observation that contrary to the findings of Baudisch (*loc. cit.*) there is reason to believe that free aquo-salt (II) exists in illuminated ferrocyanide solutions in the presence of air in the initial stage of insolation. Further Baudisch has remarked that in the presence of air and light the yellow aquo-salt (II) formed from ferrocyanide is oxidised momentarily to deep violet-coloured aquo-salt (III), which then reacts with the aquo-salt (II) to form higher complexes of pale yellow colour. The ready reducibility of the violet aquo-salt (III) to yellow aquo-salt (II) in the presence of excess ferrocyanide as noted by Williams and others and the existence of free aquo-salt in presence of ferrocyanide, however, go against the suggestion of complex formation between the two aquo-salts in aqueous ferrocyanide solutions. Experiments already in progress are expected to elucidate the mechanisms involved in the action of light on ferrocyanide.

The details of the investigation will be published in due course.

Chemical Laboratory, B. B. Lal.
Archæological Survey of India,
Dehra Dun,
July 1, 1947.

1. Lal, B. B., *Curr. Sci.*, 1947, **16**, 219 2. Baudisch, O., *Ber.*, 1921, **54B**, 414; 1922, **55**, 2701. 3. Lal, B. B., *Proc. Ind. Acad. Sci.*, 1941, **14**, Sec. A, 652. 4. Lal, B. B., and Singhal, C. P., *Curr. Sci.*, 1944, **13**, 78. 5. Piotnikow, *J. Allgemene Photochemie*, 1936, **415**. 6. Iimori, *Z. Anorg. Chem.*, 1927, **167**, 145. 7. Gallenkamp, W., *Chem. Zeit.*, 1916, **40**, 235. 8. Williams, H. E., *Jour. Chem. Soc*, 1943, 223. 9. Baudisch, O., *Ber.*, 1929, **62**, 2699

A RELATION BETWEEN REFRACTIVE INDEX AND VISCOSITY

Lagemann[1] combined Mott Souder's[2] viscosity relationship with the Lorentz-Lorenz equation and came to the conclusion that for liquids in general, a rough rule is that Mott Souder's viscosity-constitutional constant I is about twelve times the molecular refraction. It has been found that this relationship holds only for aliphatic liquids. The ratio for some simple aromatic liquids is given in the following table :

Ratios of I and M for some aromatic liquids

Compound	I	M	I/M
Benzene ..	249·9	25·96	9·6
Toluene ..	296·5	30·80	9·6
Ethylbenzene ..	344·1	35·37	9·7
o-Xylene ..	346·1	35·48	9·7
m-Xylene ..	344·1	35·64	9·6
p-Xylene ..	346·1	35·70	9·7
Aniline .	280·6	30·29	9·3
Methylaniline ..	328·2	35·24	9·3
Benzylamine ..	328·2	34·15	9·6
Ethylaniline ..	383·8	40·05	9·6
Dimethylaniline ..	383·8	40·41	9·5
o-Toluidine ..	330·0	35·01	9·4
Nitrobenzene ..	310·2	32·37	9·5
o-Nitrotoluene ..	353·8	37·05	9·5
Chlorobenzene ..	290·2	30·90	9·4
Bromobenzene ..	309·2	33·76	9·2

From the above table the conclusion may be drawn that for simple aromatic liquids Mott Souder's[1] I is roughly 9·5 times the molecular refraction.

The values of I have been taken from Mott Souder's paper and those of molecular refraction from Landolt-Bornstein Tabellen.

My thanks are due to Sir J. C. Ghosh for kind advice.

Dept. of General Chemistry, B. K. Banerji.
Indian Institute of Science,
Bangalore,
July 4, 1947.

1. *J. Amer. Chem. Soc.*, 1945, **67**, 498. 2. —, *Ibid.*, 1938, **60**, 154.

TREATMENT OF ALKALINE WATER TO RENDER IT SUITABLE FOR REELING SILK

In the course of our studies on the quality of raw silk produced in certain silk filatures in South India, some interesting observations have been made. One of the points of considerable scientific and practical importance relates to the influence of water used for cooking the cocoons and reeling the filaments on the quality of silk.

The bore-well water used in one of the silk filatures was found to affect the processing of cocoons and the quality of the silk. Although the cocoons were found to cook much quicker than in other waters, more sericin (silk gum) was dissolved in that water thereby necessitating more frequent change of water in the cooking and reeling basins. The silk threads, as they were reeled over and hanks were made, were found to retain more moisture, stick together and take longer periods to dry. After drying, hard gum spots and variations in colour, from light greenish yellow to deep greenish yellow, were noticed. These conditions adversely affected the normal properties of the silk, particularly its lustre, feel, evenness, neatness, cleanliness and its winding property. When, instead of the bore-well water, water from other sources, such as from the tank (rain-fed) in the neighbourhood or from the river about two miles away from the filature, was employed the silk reeled was free from the above-mentioned defects.

The unusual features of the bore-well water were its bicarbonate alkalinity and temporary hardness, the permanent hardness being relatively inconsiderable. 100 c.c. of the water required 33 to 40 c.c. of N/50 acid for neutralisation, and the temporary hardness was 18 to 28 parts per 100,000, as observed during different seasons over a period of four years. In view of this observation, further trials were carried out by treating the bore-well water with calculated amounts of mineral acids (such as sulphuric and hydrochloric acids) and organic acids (such as acetic, oxalic and tartaric acids) in order to neutralise the alkalinity of the water or reduce it to that of the river water which was found satisfactory for silk reeling. The results of these studies confirmed the above observations and indicated that a simple and cheap method of treating the bore-well water was just to neutralise its alkalinity or reduce it to a minimum by adding sulphuric acid (commercial grade) and vigorously stirring the water by means of an efficient blower so that no free acid was left in the water. Thus it was observed that the quality of the silk reeled in the bore-well water after treatment with sulphuric acid (0·75 c.c. of concentrated acid per gallon of the water for bringing down the alkalinity from 37 to 9 in terms of N/50 acid for 100 c.c. of the water) was comparable to that reeled in the river water (100 c.c. of this water required 8·9 c.c. of N/50 acid for neutralisation).

The practical application of the above findings under the working conditions of a filature presents some fresh problems. If the water in

the cooking and reeling basins is treated, the beneficial effect of neutralisation lasts for only a short time. Unknown quantities of fresh alkaline salts are brought in through the 'creeping' of water with the steam used for the heating. The water carried with the steam contains alkali carbonate formed through the decomposition of the alkali bicarbonate by heat. This is now sought to be remedied by the introduction of suitable traps and other devices which will introduce only dry steam. Steam jacketing of the basins would also be an elegant way of dealing with this difficulty.

If the discolouration of the silk is not material (depending upon its use) and gum spots alone are to be minimised, this can be done by drawing the silk thread through a groove containing some vaseline or other grease prior to winding round the hank. This has already been tried successfully in one filature.

A detailed account of the work including the quantitative data relating to the quality of the reeled silk will be published elsewhere.

Dept. of Biochemistry, S. C. PILLAI.
Indian Institute of Science, V. SUBRAHMANYAN.
Bangalore,
August 2, 1947.

THE CYSTINE AND METHIONINE CONTENTS OF COMMON INDIAN FOODSTUFFS

No detailed work on the analysis of foods for their contents of methionine and cystine in common Indian foods has yet been done. While the cystine content of some food proteins has been determined, very few have been analysed for methionine. The reported cystine values are on certain fractions of isolated proteins. The whole proteins of foods have not been taken into account during the analysis except for certain values reported by Chitre and Keni.[1] This is because no satisfactory methods existed, till recently, for analysing the whole proteins of foods for their cystine and methionine contents. Recently, however, reliable methods for their analyses have been developed. Apart from the microbiological method, Evans[2] has developed a wet digestion method for analysis of these constituents. The method consists in analysing the food-stuff for (*i*) Total sulfur, (*ii*) Inorganic sulfur and (*iii*) Sulfur oxidised to sulfate by nitric acid.

The above method was used in the following determinations. From the cystine and methionine sulfur values the actual amino-acid contents were calculated by using the appropriate conversion factors (3·747 for cystine and 4·651 for methionine). The combined nitric and perchloric acid digestion method[3] was used for the determination of total sulfur.

The final data about the cystine and methionine contents of the foods are tabulated below.

It will be seen that among the cereals, rice contains a high percentage of methionine. The cystine percentage is about the same in all cereals. Except for Dolichos and horsegram, the total percentage of sulfur amino-acids in all other pulses is about the same. Green-gram and the cowpea contain a large proportion of methionine. Among oilseeds, soya bean and sesamum contain a large amount of total sulfur and a fairly large proportion of methionine also. About three-fourths of the total sulfur in groundnut is, however, in the form of cystine only.

TABLE I

Cystine and Methionine Content of Some Indian Foodstuffs

(per cent. of air dry samples)

Foodstuff	Protein	Cystine	Methionine
I. *Cereals*			
*(i) Rice (*Oryza sativa*)	6·9	0·27	0·31
(ii) Ragi (*Eleusine coracana*)	7·1	0·23	0·28
(iii) Cholam (*Sorghum vulgare*)	10·2	0·24	0·21
(iv) Wheat (*Triticum vulgare*)	11·7	0·28	0·27
II. †*Pulses*			
(i) Bengal gram (*Cicer arietinum*)	17·3	0·53	0·20
(ii) Green gram (*Phaseolus radiatus*)	22·3	0·19	0·42
(iii) Black gram (*Phaseolus mungo*)	23·1	0·51	0·32
(iv) Tugar Dhal (*Cajanus indicus*)	22·2	0·59	0·32
(v) Dolichos (*Dolichos lablab*)	23·8	0·32	0·31
(vi) Horsegram (*Dolichos biflorus*)	21·3	0·42	0·14
(vii) Cow pea (*Vigna catiang*)	24·1	0·45	0·43
III. *Oilseed cakes*			
(i) Groundnut (*Arachis hypogaea*)	51·2	0·76	0·26
(ii) Soya bean (*Glycine hispida*)	50·8	1·01	0·58
(iii) Sesamum (*Sesamum indicum*)	33·1	1·12	0·59
(iv) Cotton seed (*Gossypium herbaceum*)	24·2	0·89	0·68
(v) Coconut (*Cocos nucifera*)	20·3	0·80	0·29

* Polished rice was used.

† The pulses were powdered along with the skin.

If the amino-acid contents are expressed as per cent. of the protein content, the cereals are the best sources of methionine while the pulses and the oilseed cakes constitute the richest sources of cystine.

Our thanks are due to Prof. V. Subrahmanyan for his keen interest in the work.

Dept. of Biochemistry, H. S. R. DESIKACHAR.
Indian Inst. of Science, S. S. DE.
Bangalore,
August 12, 1947.

1. Chitre, R. G., and Keni, A. B., *Curr. Sci.*, 1946, **15**, 130. 2. Evans R. J., *Arch. Biochem.*, 1945, **7**, 439. 3. Evans, R. J., and St. John, J. L., *Ind. Eng. Chem.* (Anal. Ed.), **1944**, **16**, 630.

INFLUENCE OF VARIETY, MANURING AND GERMINATION ON VITAMIN B_1 CONTENT OF GROUNDNUT-*ARACHIS HYPOGEA*

AMONG plant materials groundnut is a very rich source of vitamin B_1. The utilisation of groundnut as a source of vitamin B_1 necessitated the study of this important oil-seed from various angles.

Among 40 varieties of groundnut analysed, wide differences were noted in their vitamin B_1 content (the values varying from 5 to 20 per gram of defatted flour). These differences are attributable mainly to varietal differences since all other conditions under which they were grown are identical.

In groundnut about 48 per cent. of the total vitamin B_1 is present in bound form. The bound vitamin can be released by treatment with papain, but taka-diastase has no effect. Sodium chloride (10 per cent.) extracts completely the bound form of the vitamin. It can also be precipitated with trichloracetic acid. These results indicate that the combined vitamin exists bound to protein, and not as cocarboxylase.

It was found that both the bound and the free vitamin in groundnut are completely available, as judged by rat-growth experiments.

There was a gradual decrease in the total vitamin B_1 as the germination advanced. But the bound form of vitamin B_1 is rendered free during germination. This is attributable to the action of porteolytic enzymes formed during germination on the protein-carrier of the vitamin.

The influence of organic and artificial fertilizers on vitamin B_1 content of groundnut was studied in plot experiments at the Mysore Agricultural Farm, Hebbal. The results showed no significant differences in the vitamin B_1 content of groundnuts under different treatments.

Full details of these investigations will be published elsewhere.

Our thanks are due to Professor V. Subrahmanyan for his keen interest in the above work and also to Mr. M. J. Narasimhan, Director of Agriculture (Retd.), Mysore, and to Dr. L. S. Doraswamy, Economic Botanist, and his assistants for supplying the material used in the above investigations.

Dept. of Biochemistry, K. K. REDDI.
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Bangalore,
August 27, 1947.

RATE OF REDUCTION OF SULPHATE BY *VIBRIO DESULPHURICANS*, KONÆ

THE formation of the black ferrous sulphide associated with certain types of low-lying and boggy soils in river estuaries, coastal areas and sedimentary deposits of stagnant lakes, has generally been attributed to bacterial action; these bacteria are referred to by previous workers as *Vibrio desulphuricans*.[1] A closely allied type of organism was isolated from the black clay at a depth of about 8-10 feet on the eastern sea coast of India, where, surprisingly, a fairly rich (35 per cent.) deposit of elemental sulphur has been found to occur.[2]

The morphological and biochemical characteristics of this organism, have been described earlier.[3,4] The organism differs from the spirullum of Czurda[5] in that (1) it can reduce sulphate even in absence of carbon dioxide and (2) it is capable of utilising ethyl alcohol and sucrose as the sources of carbon; in other respects they agree. The present communication deals with a study of the rate of reduction of sulphite by *Vibrio desulphuricans*, Konæ.

The nutrient medium was composed of sodium chloride (6 per cent.), recrystallised sodium sulphate (1·0 per cent.), dipotassium hydrogen phosphate (0·2 per cent.), ammonium lactate (0·4 per cent.) and ferric chloride (0·2 per cent). The salts were dissolved in distilled water, the pH adjusted to 7·4 and the volume made up to 100 ml. and sterilised.

Aliquots (10 ml.) of this medium were distributed into sterile bacteriological tubes and the tubes again sterilised at 10 lbs. for 30 minutes. The tubes were then inoculated, each with 1 ml. of a suspension of carefully washed bacterial cells dispersed on 6 per cent. saline and incubated at 30° C.

For estimating the initial concentration of the sulphate, a couple of tubes, immediately after inoculation, were heated in a boiling water-bath to inactivate the bacteria. The sulphate was estimated volumetrically by the benzidine sulphate method.[6] The filtered culture medium (2 c.c.) was acidified with HCl in a centrifuge tube, mixed with a solution of benzidine hydrochloride. The tubes were then cooled in a freezing mixture for 30 minutes and 2 ml. of 95 per cent. alcohol were then added. This facilitated the sedimentation of the thin platelets of benzidine sulphate on centrifugation. The precipitate was washed (four times) with ice-cold 50 per cent. alcohol and transferred to a 25 ml. conical flask and titrated against 0·02 N sodium hydroxide from a microburette. The results are given in Table I and are graphically represented in Fig. 1.

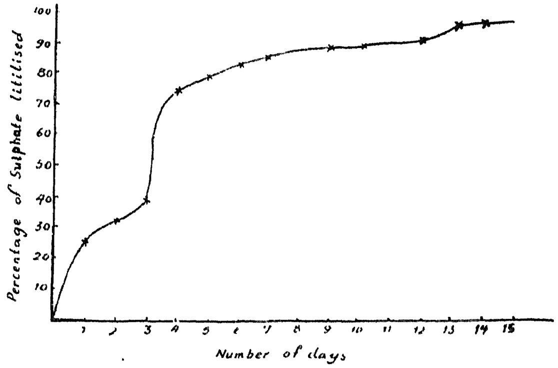
TABLE I

Rate of Reduction of Sulphate by Vibrio desulphuricans *Konæ*

No. of days	SO_4'' present (mgm./2 c.c.)	SO_4'' utilised (per cent)
0	5·91	4·40
1	4·40	25·50
2	3·95	33·10
3	3·27	39·10
4	1·47	75·30
5	1·24	79·40
6	0·99	83·30
7	0·84	85·90
9	0·68	88·50
10	0·65	89·00
12	0·53	91·00
13	0·23	96·30
14	0·23	96·30

The data (Fig. 1) reveal many interesting facts. The rate of reduction of sulphate does

not remain steady; it appears to get suddenly accelerated after 72 hours, maintaining this high rate steady for the next 24 hours. It is during



this period of 24 hours that more than a third of the sulphate is reduced. This period probably corresponds with the period of the growth phase of bacteria. This coincidence is suggestive of the fact that bacteria utilise the oxygen of the sulphate for their metabolic function. The striking fall in the rate of reduction after 96 hours is possibly due to a diminution in concentration of the lactate and the sulphate in the reaction mixture. Further work on the relation between the amount of lactate utilised and the sulphate reduced is in progress.

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Bangalore, India,
September 9, 1947.

1. David Ellis, "*Sulphur Bacteria*" *Monograph*, 1932. 2. K. K. Iya and M. Sreenivasaya *Curr. Sci.*, 1944 **13**, (12), 316-17. 3. —, *Ibid.*, 1945, **14** (9), 243-44. 4. —, *Ibid.*, 1945, **14** (10), 267-69. 5. Viktor Czurda, *Arch. Mikrobiol.*, 1940, **11**, 187-204. 6. Raschig, *Z. anal. Chem.*, 1903, **42**, 617, 818.

THE YELLOWING OF JUTE

STUDIES on the mechanism of discolouration of jute were conducted on samples of jute yarn and powder, subjected to acclerated ageing by irradiation in quartz containers, with light from a quartz mercury-vapour lamp, under various atmospheric conditions. The colours produced on the yarn samples were assessed by a photometric method. It was found that air, oxygen, or ozone did not produce any change of colour in the dark. Furthermore, the discolouration due to the light source was as great in the presence of purified nitrogen as in that of oxygen. The reactions which lead to discolouration are not, therefore, oxidative, as suggested by Sarkar and his colleagues,[1] but photochemical.

Samples of irradiated and non-irradiated jute powder were analysed for main components and a number of associated functional groupings. All the main constituents of jute were found to undergo change during irradiation. Thus, there is a small but distinct loss in the cellulosic fraction, which comprises true cellulose and cellulosan; a very marked decrease in the lignin content, as determined by the residue left after treatment with strong mineral acid; and a reduction of the xylon content as determined by the yield of furfuraldehyde. A large increase in the copper number during irradiation in the presence of oxygen indicates that the cellulosic portion of jute undergoes chain cleavage, and the small gain in uronic acid content suggests oxidation at the terminal carbinol group, similar to the effect demonstrated by Lewis and Frommuller[2] during the irradiation of wood.

Since purified cellulose undergoes a number of well-authenticated changes but does not discolour during irradiation, it seems unlikely that the cellulosic portion of a lignocellulosic fibre contributes to its photochemical discolouration. This is supported by the fact that degradation of the cellulosic portion of jute is more advanced during irradiation in oxygen than in nitrogen, whereas the degree of discolouration is the same in both cases. Moreover, the degradation products of irradiation of cellulose do not seem to be reactive. Discolouration of the lignocellulosic materials must, therefore, be due to either the ligneous or the hemicellulosic portion or both. The probability that both these fractions contribute to the discolouration has previously been stated.[3] Sarkar[4] has since shown that delignified jute is discoloured by light and heat and concludes that the residual hemicellulosic constituents are responsible for this. During the accelerated ageing of delignified jute it is difficult to visualise that components other than those of hemicellulose could contribute to the discolouration.

In the after-yellowing of raw jute, however, it is important that the role of the hemicelluloses should not be over-emphasised. The light-yellow colouration obtained during irradiation of delignified jute is quite distinct in appearance from the yellow-brown colour obtained with raw jute and indicates that in the latter case the ligneous portion makes the greater contribution to the discolouration reactions.

The major portion of the yellow-brown colour derivatives can be extracted from irradiated jute with water or alcohol, and the aqueous extract, for example, shows that quinonoid reaction products are formed. These, no doubt, are derived from the ligneous portion of the jute, since the formation of quinonoid derivatives from this portion of the lignocellulose materials is well established. There is a loss of methoxyl content in lignin during irradiation of jute. Phenolic substances capable of being transformed to the coloured quinnoid type are therefore held to give rise to those coloured products derived from the ligneous portion. Degradation of the hemicellulose portion with the prior formation of furfural and subsequent conversion of the aldehyde to coloured polymers is believed to be the contribution of the hemicelluloses to the discolouration.

Preliminary reports[1,2,3,4] show that progress has been achieved towards inhibition of the colour changes. Inhibition of the photochemi-

cal changes can be brought about in raw jute by certain esterification and etherification treatments, among which acetylation gives complete protection, whereas methylation with an ethereal solution of diazomethane affords only partial protection. After these treatments it is probable that substituted polyphenols which are incapable of quinone formation are produced during irradiation. The introduction of acetyl groups has the two-fold effect of preventing the formation of coloured quinones and causing the production of a bleaching agent during irradiation. Methylation, on the other hand, duly prevents quinone formation, but does not repress any discolouration due to aldehydic polymerisation. Furthermore, it has been noted that the colour obtained during irradiation of methylated jute resembles the yellow colour which results from the accelerated ageing of delignified jute.

Meanwhile, Sarkar and his colleagues[1] have shown that delignified jute does not discolour if immersed in ethyl alcohol. The mechanism of this inhibition reaction, stated by the authors to consist of the preferential oxidation of the alcohol is rendered untenable in view of the fact that, as shown above, the presence of oxygen is not necessary for the formation of coloured derivatives. Preferential absorption of the particular wave-band responsible for the discolouration reactions, by such an applied substance is, however, more likely to lead to success. Initial removal of potential colour-producing substances and replacement by an artificial resin may be possible.

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The University,
Leeds,
(Indian Jute Mills Association Research Institute),
August 11, 1947.
H. J. CALLOW.

1. Sarkar, Chatterjee, Mazumdar and Nodder, *Curr. Sci.*, 1947, **16**, 74. 2. Lewis and Fronmuller, *Paper Trade J.*, 1945, **121**, *Tappi Sect.*, **133**. 3. Atkins and Callow, Provisional B. P. 22366/46. 4. Peill, *Nature*, 1946, **158**, 554. 5. Callow, *Ibid.*, 1947, **159**, 309.

YELLOWING OF BLEACHED JUTE—FURTHER OBSERVATIONS

DISCOLOURATION of raw jute and yellowing of the fully bleached fibre on exposure to light or on storage may not be due to the same changes in so far as the role played by the hemicelluloses alone is concerned, for the hemicelluloses in the raw fibre are not, in all probability, identically the same as those in delignified jute. Apart from oxidative changes (jute holocellulose prepared with sodium chlorite dissolves appreciably in very dilute NaOH solution at room temperature with a yellow colour) there is the cleavage of a chemical bond between lignin and polyuronide hemicelluloses (some recent observations in these laboratories appear to confirm this). Our note in *Current Science*[1] was exclusively on the yellowing of fully bleached jute; so I must confine my remarks to this problem only. We have observed that delignified jute turns appreciably yellow even when stored in the dark (in thick glass tubes covered several times with black paper) though to a slightly lesser extent than in diffused light. The changes leading to yellowing of bleached jute on storage does not, therefore, appear to be exclusively photochemical.

Since the publication of the note, further important observations have been made in this regard which necessitate modification of a view expressed therein. Delignified jute stored under benzene has been observed to turn yellow to the same extent as that kept under alcohol containing a little water. Since aqueous alcohol cannot prevent the yellowing of bleached jute as absolute alcohol does, our explanation on the basis of preferential oxidation, offered earlier, does not stand. Some agent other than oxygen is possibly responsible for the yellowing; this apparently supports the view of Mr. Callow expressed in the foregoing note.

But the following observations would indicate that the presence of moisture in the delignified fibre is essential for the development of yellow colour on storage. (*i*) A sample kept over fused calcium chloride in an ordinary desiccator for more than a year has not turned yellow as yet. Another sample placed over conc. H_2SO_4 in an ordinary desiccator has turned very slightly brownish. (*ii*) A similar sample, stored over saturated NH_4Cl solution in a vacuum desiccator turned yellow just like the control, exposed to air. In view of these facts, the protection afforded by absolute alcohol would seem to be due to its dehydrating nature. Further experiments are in progress.

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1. Sarkar, *et al.*, *Curr. Sci.*, 1947, **16**, 74.

SOME NEW CHEMICAL AGENTS FOR CONTROL OF RABBIT COCCIDIOSIS

COCCIDIOSIS is a common cause of mortality both in poultry and rabbits. In the latter, *Eimeria stiedæ* (Lindemann) and *E. perforans* (Leuckert) are discharged as unsporulated oöcysts by chronic carriers. *E. stiedæ* attacks the liver and causes unusual hypertrophy of the organ owing to the proliferation of biliary epithelium and bile ducts.[1] *E. perforans*, on the other hand, causes acute enteritis. Mixed infections by both the parasites resulting in very quick death of the host are not uncommon. Reports of successul attempts of control of coccidiosis in rabbits with sulfasuxidine and pthalylsulfathiazole have recently been made.[2,3] The result of trials conducted by the author with 14 chemical agents for destroying the rabbit coccidian oöcysts *in vitro* are given in Table I.

Fresh, washed, unsegmented oöcysts from the liver and intestine of infected rabbits were suspended for 24 hours in sporulating dishes containing each of the reagents. At the end

of the period the number of oöcysts that were dead and alive out of 300 were counted, the live ones containing bright, compact zygotes and the dead ones having macerated zygotes and distorted walls.

TABLE I

Mortality percentages of the oöcysts of E. stiedæ *and* E. perforans *when treated with different chemical agents*

Reagent	Strength of Solution %	Mortality percentages	
		E. stiedæ	*E. perforans*
Carbolic acid ..	2	58	18
Copper sulphate	10	10	12
Caustic soda ..	2	10	15
Formal ..	5	15	10
Mercuric chloride	1	25	20
Mono-chlor-oxylenol	9	100	100
Sulphosalycilic acid	10	15	10
Hydrochloric acid	2	40	12
Terpineol ..	3	100	100
Iodine ..	2	60	75
Picric acid ..	Saturated Solution	10	12
Potassium per-manganate	2	10	40
Phenol ..	15	16	18
Sodium salycilate	2	8	5

The table shows that 5 per cent. terpineol and 9 per cent. monochloroxylenol are the most effective in destroying the oöcysts.

In a case of outbreak of coccidiosis in a rabbit colony the spreading of the disease can be checked by: (1) removal of the infected animals either by death or isolation, (2) therapeutic measures and (3) preventing the access of parasites to the uninfected animals by killing the oöcysts. The present findings, therefore, open up the possibility of using 3 per cent. terpineol or 9 per cent. monochloroxylenol effectively for the latter purpose.

I wish to thank Dr. J. G. Carr of the Institute of Animal Genetics for placing the infected rabbits of his experimental colony at my disposal.

The Institute of Animal Genetics,
University of Edinburgh,
Scotland, AMIYA B. KAR.
(Now at the Department of
Poultry Husbandry,
Section of Animal Genetics,
Ithaca, New York),
December 20, 1946.

1. Jankiewicz. H. A., *J. Parasit.*, 1945, **31**, 18. 2. —, *Ibid.*, 15. 3. Lund, E. E., *Ibid.*, 11.

EXTRACTION OF VISCERAL OIL FROM INLAND WATER FISHES IN THE COLLAIR LAKE AREA, MADRAS[1]

THE pyloric cæca, intestine and fat bodies of many fishes contain a good quantity of oil, indicating the distribution of vitamin A in these organs.

The extraction of oil from the viscera of the following species of inland water fishes is a cottage industry around the Collair Lake: (*a*) *Macrones gulio* (Ham.), (*b*) *M. cavasius* (Ham.), (*c*) fingerlings of *Labeo fimbriatus* (Bloch.), (*d*) fingerlings of *L. calbasu* (Ham.), (*e*) *Cirrhina reba* (Ham.), (*f*) *Barbus sarana* (Ham.), (*g*) *B. sophore* Hamilton, and (*h*) *B. ticto* (Ham.). The fish, after the removal of the viscera, are salted and dried, and exported to the Ceded Districts and to the Mysore State.

The viscera are treated with water in flat mud pots over a slow and steady fire. After about one half hour the boiling viscera are slightly stirred and pressed with a wooden ladle. The dark-yellow oil is then filtered through cloth and stored in mud vessels (yield, 20 per cent.) About 10,000 pounds of oil are thus extracted annually in this area.

The following is the analysis of the gut contents which are not removed from the viscera utilised for oil extraction:

(*a*) *Macrones gulio*: *Copepods*, *Fragillaria*, *Pleurosigma*, *Barbus* spp., fish-eggs, fish-scales, larval worms, *Oryzias melastigma*, prawns, and sand particles.

(*b*) *M. cavasius*: Appendages of crabs, insect remains and mud.

(*c*) *Labeo fimbriatus*: *Closterium*, *Copepods*, *Coscinidiscus*, *Cyclotella*, daphnids, *Fragillaria*, insect remains, *Navicula* and sand particles.

(*d*) *L. calbasu*: *Caridina* sp., *Chætomorpha*, *Closterium*, Copepods, *Cosmarium*, Cypris, Daphnid, insect larvæ, *Lyngbia*, Mysids, *Oscillatoria*, *Pandorina*, Rotifers, *Spirogyra*, *Synedra*, and sand particles.

(*e*) *Cirrhina reba*: *Oscillatoria*, *Lyngbia* and *Rhizoclonium*; and daphnids, insect larvæ, *Navicula*, *Pinnularia*, Rotifers, *Tabellaria*, and mud.

(*f*) *Barbus sarana*: Eunotia, fish-scales, *Fragillaria*, insect remains, *Mastogloia*, *Navicula*, *Nitschia*, *Pinnularia* and sand grains.

(*g*) *B. sophore*: Algal filaments, *Bacillaria*, *Coscinodiscus*, *Cosmaria*, *Cyclotella*, *Eræmosphæra*, *Fragillaria*, *Gomphonema*, *Melosira*, *Navicula*, *Nitzschia*, *Pediastrum*, *Surirella*, *Stauroneris*, *Tabellaria*, Volvox and sand particles.

(*h*) *B. ticto*: *Anabæna*, *Bacillaria*, copepods, *Cyclotella*, daphnids, *Eunotia*, *Fragillaria*, insect remains, insect larvæ, *Mastogloia*, *Navicula*, *Nitzschia*, *Pinnularia*, *Spirogyra*, *Tabellaria* and sand grains.

Vitamin A potency of the oil varied from 50 to 330 International Units per gram, with an acid value of 31·4.* Though the presence of vitamin A enhances the food value of the oil, it is mainly used for lighting as a substitute for kerosine. 10 c.c. of the oil keeps a cotton wick burning for three hours. The residue from oil extraction is dried and used as poultry food. The large-scale exploitation of these

species of fishes for their visceral oil may be economically justifiable.

Inland Fisheries Office,
8, Ormes Road,
Kilpauk, Madras,
June 1947.. P. I. CHACKO.

1. Read before the Zoology Section at the 33rd Indian Science Congress, 1946, and communicated by permission of the Director of Industries and Commerce, Madras. 2. Jowett, W. G., and Davies, W., *A Chemical Study of Some Australian Fish*, 1938.

* This analysis was conducted in the Nutrition Research Laboratories, Coonoor, and in the Government Oil Factory, Calicut.

SQUILLA HIEROGLYPHICA KEMP.

MR. KURIYAN's note on the occurrence of *Squilla hieroglyphica* along the Travancore coast is indeed of considerable interest in view of the fact that the present record extends the range of this rare Indo-Pacific Stomatopod to the west coast of India also. However, his surmise that the species does not appear to have been recorded since Kemp's original description is not quite correct. Kemp[2] himself collected a second specimen from the Philippines in 1915. It was a female, 48 mm. long. The third record of the species was from the Madras coast. The present writer[3] collected an *Alima* in the final pelagic stage from the Madras plankton, reared it in the laboratory through metamorphosis and identified the post-larva as *S. hieroglyphica*. Not only has the species thus been recorded from the Indian waters, but its pelagic larva has also been described and figured. The close resemblance of this Indo-Pacific species to *S. hildebrandi* recently described by Schmitt[4] from the Panama Canal zone was also pointed out by the writer.

The specimen recorded from Travancore is, therefore, the fourth known so far, and it would appear that the species is not altogether so very rare in the Indo-Pacific region.

Hydrobiological Research Station,
Government Fisheries,
Madras,
July 10, 1947. K. H. ALIKUNHI.

1. Kuriyan, C. V., *Curr. Sci.*, 1947, **16**, 124. 2. Kemp, S., *Philippine J. Sci.*, (D), 1915, **10**, 3. Alikunhi, K. H., *Curr. Sci.*, 1944, **13**, 18. 4. Schmitt, W. L., *Rept., Allan Hancock Pacific Exped.*, 1940, **5**, 4.

THE MIGRATORY FISHES OF THE INLAND WATERS OF MADRAS

IN accordance with the resolution of the Advisory Board of the Indian Council of Agricultural Research for a survey of the fishery resources of water-ways, a preliminary survey of the migratory fishes of the Madras Province was conducted by me. The following are the salient features of this survey.

The four major rivers in the Madras Presidency, namely, the Godavari, the Kistna, the Tungabhadra and the Cauvery, are generally in floods from June to December, when they are characterised by muddy discolouration, great velocity of flow and fluctuating depth. By the end of January the river recedes, and these rivers soon dwindle into a few scattered pools which may be interconnected by narrow strips of shallow water until the next year's floods raise the levels again.

It is found that first freshets stimulate the migratory impulse in the various species; and with the rise, swell and discharge of the mingled waters the migration is soon in full swing. The migratory fishes in the rivers of Madras can be grouped into four classes, namely, those (1) entering the rivers from the sea, (2) descending the rivers into the sea, (3) moving up and down the upper reaches, and (4) showing local migrations in the plains.

The Hilsa, *Hilsa ilisha* (Ham.), is one of the most commercially important fishes, ascending the rivers for feeding and breeding. In the Godavari alone this fish yields an annual fishery worth about Rs. 100 lakhs, and in the Kistna and the Cauvery it contributes substantially to the bulk of the riverine crop. Under existing conditions of these South Indian rivers the Hilsa exhibits the longest migration. In the Godavari, it has been observed to go upwards to a distance of 210 miles from the sea, *i.e.*, up to the Dummagudem Anicut. The Bekti, *Lates calcarifer* (Bloch.), the Jew Fish, *Sciœna belangeri* (C. & V.), and the Mullet, *Mugil olivaceus* Day, ascend the rivers, particularly the Godavari and Kistna, in fairly large numbers, to a limit of 80 miles from the sea. Thus, specimens of these species were caught from Polavaram and Bezwada. Stray specimens of the Tarpon, *Megalops cyprinoides* (Broussonet), the marine glass fish, *Ambassis commersonii*, C. & V., and of the Indian Salmon, *Polynemus tetradactylus* Shaw, were observed up to the Godavari Anicut, about 60 miles from the sea. Gonadial examination has not revealed that these species migrate far into the river for spawning. It is presumed that they ascend the rivers only for feeding.

The freshwater eel, *Anguilla bengalensis* (Ham.), which migrates from freshwater to the sea for spawning, is but poorly represented in the rivers and other waters of Madras.

The species which move up and down the upper reaches of the rivers for breeding and feeding are (1) the Carnatic Carp, *Barbus carnaticus, Jerdon.*, (2) the Brown Mahseer, *B. hexagonolepis*, McClell, (3) the Mahseer, *B. tor*, (Ham.), and (4) the Goonch, *Bagarius yarrellii* (Ham.). The Mahseer has been observed to breed in the upper reaches of the Cauvery, Bhavani, Tungabhadra and Godavari; and the Carnatic Carp and the Brown Mahseer in the upper reaches of the Cauvery. The Goonch breeds in the Tungabhadra.

The species which show local migrations in the plains are chiefly (1) *Wallago attu* (Bl. Schn.), (2) *Callichrous bimaculatus* (Bl.), (3) *Pangasius pangasius* (Ham.), (4) *Silundia silundia* (Ham.), (5) *Marcones aor* (Ham.), (6) *M. seenghala* (Sykes), (7) *Labeo fimbriatus* (Bloch.), (8) *L. calbasu* (Ham.), (9) *Cirrhina cirrhosa* (Bl.), (10) *C. reba*, Ham., (11) *Catla catla* (Ham.), (12) *Thynnichthys sandkhol* (Sykes), (13) *Barbus sarana* (Ham.), and (14) *B. dubius* (Day).

Large numbers of berried individuals of four species of prawns, namely, *Palæmon malcolmsonii* H. Milne-Edwars., *P. scabriculus Heller*., *Penæus indicus* Milne-Edwars., and *Metapenæus monoceros* (Fabr.) (kindly identified by Dr. B. N. Chopra, Zoological Survey of India), occur in the Godavari river both above and below the anicut, and contribute to a prawn fishery, indicating thereby that these shell fishes breed in the river during the flood season. The occurrence of *Penæus indicus* in the river to a distance of 100 miles from the sea is of special significance, as various workers have stated that this specie breeds only in the inshore sea or in bays and estuaries. A fairly good percentage of the shoals of *Palæmon malcolmsonii* was found infested by the Bopyrid parasite, *Pelægyge alcocki* Chopra.[1]

The measures adopted by the Madras Fisheries for the development of the river fisheries are: (1) conservancy operations to a distance of one mile below all dams and anicuts, and below the Hogainakkal Falls in the upper reaches of the Cauvery, (2) protection of immature fish in the upper reaches of the Bhavani and Moyar rivers, (3) observation of a close season for Hilsa for a stretch of one mile below the first anicut across the Godavari, Kistna and Coleroon, (4) protective legislation against the destruction of immature carps in the canal system of the Kistna river, and (5) artificial propagation of Hilsa in a hatchery at Bobberlanka in the Godavari delta.

The future existence and development of the fluviale fisheries of our country depend not only on the ability of the adult migratory fishes to perpetuate themselves but also on the ability of the young to complete its larval and post-larval development and to be successfully distributed into favourable environments and attain commercial size. Artificial and natural barriers prevent the fishes from reaching all the natural spawning grounds which should be available to them. Continuance of such obstructions might in course of time lead to the disappearance of the fish even from the lower waters of the river. Detailed investigations regarding the suitability and efficiency of fish passes with reference to local topography and hydrography, and leaping capacity, migratory habits and preferences of the species concerned remain to be pursued by fishery workers in collaboration with the personnel in charge of irrigation and hydro-electric projects. Hora[2] has recently outlined a plan of work for this investigation.

I am thankful to Dr. T. J. Job, Deputy Director of Fisheries, Madras, for his suggestions during my survey work.

Inland Fisheries Office,
Kilpauk, Madras,
July 1947.

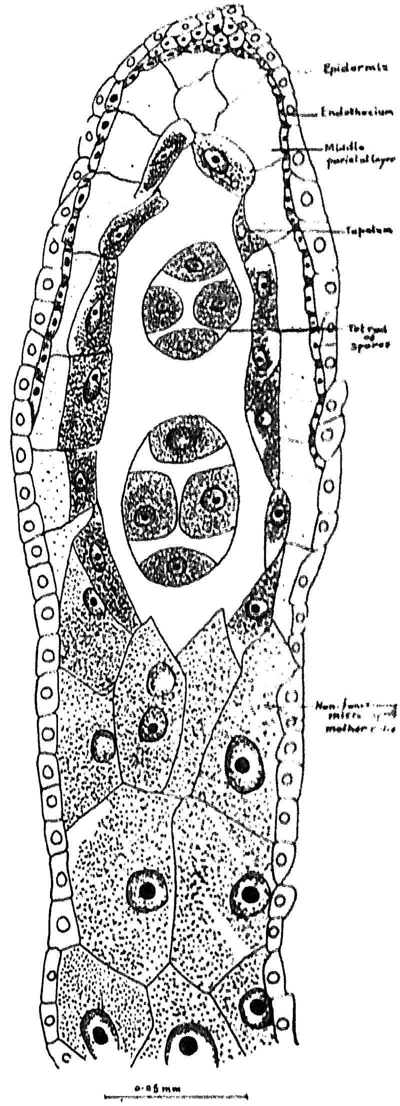
P. I. CHACKO.

* This note has been communicated with the kind permission of the Director of Industries and Commerce, Madras.

1. Chopra, B. N., *Rec. Ind. Mus.*, 1923, **25**, 495.
2. Hora, S. L., *Cent. Board. Irri.*, **1947**, **4**, 10.

DEGENERATIONS IN *LEUCAENA GLAUCA*, BENTH.

IN Mimosaceæ sterility had been observed in several species, but it is only in *Albizzia lebbek*[1] and *Acacia Baileyana*[2,3,4] that degenerations have been studied in some detail. In *Leucæna glauca*, degenerations have been observed both in the anthers and ovules.



L.S. Microsporangium

In this plant it was observed by the author that degenerations during microsporogenesis occur at a comparatively early stage. In some microsporangia only a few microspore mother-cells underwent division, ultimately giving rise to the tetrads of spores, the rest of microspore mother-cells failing to show the slightest indication of division. The figure represents an interesting case in which both the microspores and undivided microspore

mother-cells were seen in the same microsporangium. As a consequence, very few pollen grains developed in each of such microsporangia.

A feature of interest in the embryology of *Leucæna glauca* and directly connected with the degenerations of the microspore mother-cells was in regard to the tapetum. This, as the figure shows, instead of being a continuous layer completely surrounding the microsporangium, developed only in contact with the functioning microspore mother-cells and did not extend around the non-functioning microspore mother-cells. The explanation of the peculiar tapetum is obvious. It developed to nourish the dividing microspore mother-cells and the resultant microspores, and it did not show any development where the microspore mother-cells had stopped functioning.

Further, it may be noted that in the lower part of the microsporangium, the parietal layer did not show any periclinal division, there being thus no endothecium or middle layer which were, however, clearly differentiated in the upper part.

Degenerations in the ovules were found to occur at any stage after the formation of megaspores, but they were more common after the four-nucleate stage of the embryo-sac involving any of the nuclei of the sac.

Detailed account will be published elsewhere. The author is grateful to Prof. R. L. Nirula for valuable help, suggestions and criticisms.

Department of Botany,
College of Science,
Nagpur,
August 28, 1947. V. R. DNYANSAGAR.

1. Maheshwari, P., *J. Indian Bot. Soc.*, 1931, **10**, 241. 2. Newman, I. V., *J. Linn. Soc.* (*Bot.*), 1933, **49**, 147. 3 —, *Proc. Linn. Soc. New South Wales*, 1934, **59**, 237. 4. —, *Ibid.*, 1934, **59**, 297.

SEEDLING BLIGHT OF SAFFLOWER *CARTHAMUS TINCTORIUS* L.

THIS disease was first observed during April 1947 among potted safflower seedlings about six weeks old grown for experimental purposes. Incidence of the disease was high during cloudy days when the temperature fell below 25° C., and losses amounted to over 75 per cent., sometimes being as high as 90 to 95 per cent. The most common mode of infection was in the terminal bud or in young leaves, starting as a small brown water-soaked lesion which spread rapidly involving the entire plant in a decay characterised by the water-soaked and shrunken appearance of the affected portions (Fig. 1). Death usually resulted in 12 to 15 days. Infection starting at the collar region from where the rot spread upwards, soon involving the entire plant was also seen in some cases.

Isolations made with surface-sterilized bits of diseased tissue consistently yielded pure growths of a *Phytophthora* which was later identified as *P. palmivora* Butler, a species common in South India. The pathogenicity of the fungus was proved repeatedly by isolation and inoculation (Fig. 2). High level of humidity favoured rapid spread of the disease.

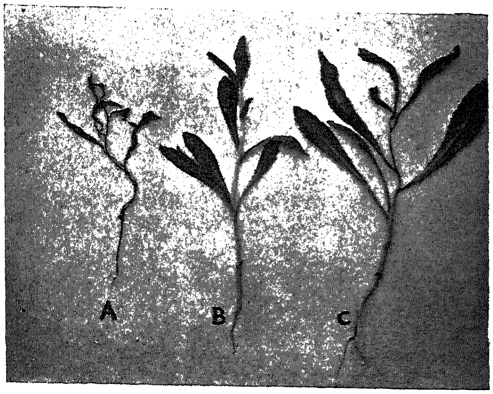


FIG. 1. Seedlings of *Carthamus tinctorius* L. showing various stages of infection: *A.* Totally blighted seedling; B. Healthy seedling; *C.* Seedling showing die-back of the younger portions.

The fungus grew well on most agar-media, producing luxuriant aerial mycelia. Spherical or limoniform sporangia and sub-spherical to spherical chlamydospores were also produced in abundance, the sizes of these structures agreeing with those given by other workers for this species. As, however, the fungus did not produce any oöspores in pure culture even

FIG. 2. Blighted (A) and healthy (B) seedlings Photograph taken ten days after inoculation.

after three months, attempts were made to induce oöspore formation by growing it in paired cultures with known plus and minus strains of *P. palmivora* available in the Government Mycologist's stock culture collection at Coimbatore. The isolate from safflower formed oöspores in 7 to 10 days when grown with plus strains from *Areca catechu* L. (Bombay), *Cyphomandra betacea* Sendt. (Burliar, Nilghiris), *Lycopersicum esculentum* Mill. (Coimbatore) and *Colocasia antiquorum* Schott. (South Kanara), while it did not form any oöspores even after one month when grown with minus strains isolated from *Hibiscus esculentus* L. (Coimbatore), *Carica papaya* L. (Coimbatore), *Hevea brasilensis* Muell. (Travancore) and *Areca catechu* L. (Bombay), thereby showing that it is a minus strain of *P. palmivora*. No

species of *Phytophthora* appears to have been recorded on this host so far.

M. S. BALAKRISHNAN.
Mycology Section, C. S. KRISHNAMURTHY.
Agric. Research Institute,
Coimbatore, S. India,
September 4, 1947.

THE RUST OF SAFFLOWER *PUCCINIA CARTHAMI* (HUTZ.) CORDA

THE rust which infects the leaves of safflower, *Carthamus tinctorius* L. (Fig. 1), is quite common in Peninsular India and has been observed year after year in this Institute in the month of March. Its life-history has not been studied in this country, and nothing is known of its annual recurrence. There is no record in literature to show if the germination of its teleutospores has been observed anywhere. Conners and Savile[1] demonstrated experimentally that it is a brachy-form rust with a tendency towards short-cycling, and obtained evidence of the teleutospores on the seed infecting the young crop in Canada. It appears, however, that they did not observe the germination of teleutospores on the slide, and nothing is known of the influence of environmental conditions on their germination. The writer was able to get successful results which are reported here.

FIG. 1. A rusted leaf of safflower

The appearance of uredo sori of the rust was observed on the crop in this Institute on 22nd March 1947, and teleutospores were formed in the same sori a fortnight later. Some leaves bearing the teleuto stage were collected and soaked overnight in tap water. The teleutospores were then spread out on a thin film of water on glass slides and put for germination in moist chambers at 5°-7°, 12°-14°, 18°, 26° and 30°-35° C. (room temperature). After three days germination was observed only at 12°-14° and 18° C.; germination was 25 and 60 per cent. respectively.

A culture of the rust was established in the uredo stage on safflower seedlings in the laboratory. The same results were obtained when teleutospores from these pot cultures were kept for germination at different temperatures mentioned above.

On germination both cells of the teleutospores produce stout, four-celled promycelium and from each cell of the latter a basidiospore develops on a short sterigma (Fig. 2). The basidiospore germinates *in situ* giving rise to a thin and short wavy germ tube (Fig. 3).

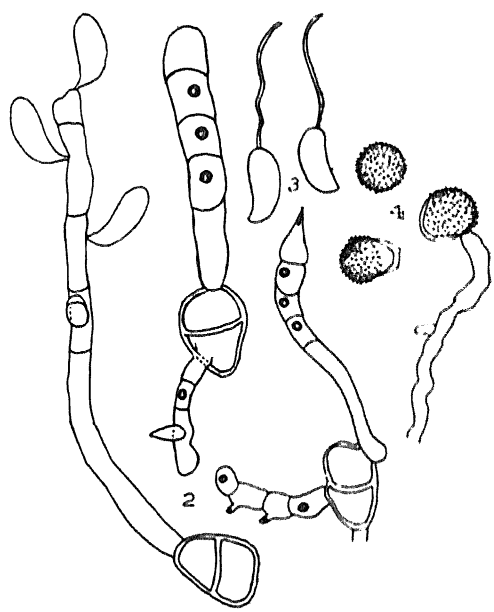


FIG. 2. Germinating teleutospores ×250.

FIG. 3. Germinating basidiospores ×250.

FIG. 4. Uredospores; one germinating. ×250.

Germination of fresh uredospores taken from pot cultures was found to be copious between 12°-26° C. with optimum near 18° C. No germination was observed at 5°-7° C. and only traces of it at room temperature (30°-35° C.) (Fig. 4).

Further studies are in progress.

Division of Mycology and
Plant Pathology, RAGHUBIR PRASADA.
Indian Agricultural Research
Institute, New Delhi,
June 10, 1947.

1. Conners, I. L., and Savile, D. B. O. 23rd Ann. Rep. of the Canadian Plant Disease Survey, 1943, *Ibid.*, 28, 1944.

ON THE FACILITIES FOR PRACTICAL TRAINING IN FOREIGN COUNTRIES

I WRITE this in view of the prominence you have given in your July 1947 issue, to the matter of the difficulties experienced by Indian students for getting admitted into works and factories abroad.

What else do you expect? Factories and works all over the world are not philanthropic institutions to distribute their experience gratis.

It is recognised by every one including the sponsors of the wholesale technical foreign scholarships, that the entire scheme is futile. Prof. A. V. Hill declared that one way of paying off sterling balances was by the institution of these scholarships, and it certainly fulfils this.

Works and factories will welcome aspirants if they stand to gain some benefit themselves. If you undertake to buy their product or plant in substantial quantity, then you can not only get welcomed but even insist on the training of as many scholars as you wish. There is the well-known instance of the Persian (present Iranian) Government enforcing the training of its nationals in petrol technology in return for oil concessions to the powerful Oil Companies.

One member of the Scholarship Committee declared that a big electrical concern suggested that rather than send single individual scholars to their works, it would be more profitable to send a team of a dozen or a score of men who will be put through the activities of their whole organisation. It appears this excellent scheme was turned down by the Government of India at the time.

Why should it not be adopted now? I would also like to ask how many industrial concerns in India will offer to train scholars gratis. It is in the experience of many of us that even visitors are discouraged in most of them.

It will be a good thing if the future Government made a statutory rule, that every industry in India should give training to suitable candidates, on payment of a premium or in some other form which may be determined. The huge amount of money now spent aimlessly abroad, may then be usefully diverted inside the country, and to better purpose.

Uttarpara P.O.,
Dt. Hooghly,
Bengal,
August 8, 1947.

M. RAJAGOPALAN.

ENCOURAGEMENT OF SCIENTIFIC TALENT IN THE COUNTRY

IN a recent issue of *Current Science*,* Sir T. S. Venkataraman has drawn pointed attention to want of proper recognition and encouragement of scientific talent in the country. Coming from a person of his standing and experience, his advice is entitled to much respect.

One of the well-known defects of scientific investigators in the country is the tendency to take up a number of scientific problems, generally beyond the scope of a single individual to tackle. There is very little of intense specialization, which is so characteristic of leading foreign laboratories and which, as in the case of Sir Venkataraman himself, can lead to outstanding achievement. The author of this note is himself a big sinner in this respect. This fissiparous tendency, as Dr. G. J. Fowler has often described it, is not always the result of one's own choice. The problems are often thrust on the people concerned and one's confirmation or promotion would depend on the number of enquiries 'disposed off' in the course of a year. The Head of an important laboratory once complained that he was expected to deal with fresh problems at the rate of one, and often two, per week! In research laboratories, selection of different lines of work is often the result of a combination of factors—the need for additional financial assistance which could be obtained only on the basis of different programmes of research; and provision of encouragement for and even subsequent employment of the associated research students. In Europe and America, it is not uncommon to find one trained in protein chemistry taken up by the petroleum industry. In India, unless a person is associated, at least in a small way, with a particular line, he has no scope for employment in that line. That is due to the very limited opportunities for employment in the country.

It is not always that a scientist willingly gives up active research to take up an administrative position. Contributions to science do not always count in life, and a senior worker in India may find that, even after several years of good work, he remains in the same position and draws the same emoluments, while his own needs and commitments go on increasing. He sees no scope for advancement under such conditions and has soon to make up his mind between continuing in the same position or securing an administrative position with higher emoluments, better status and power of patronage.

If the scientific man-power committee is to function effectively, it should first work out a procedure for finding scientific talent, wherever it may exist in the country. An obvious method will be to maintain a register or card-index relating to all the scientific workers. This will not, by itself, reveal much, as most of the information will have to come from the worker himself who is an interested party. Confidential notes from heads of institutions and departments may be more helpful, but they may not always be unbiased. An alternative will be to have a permanent commission consisting of quite senior people of high scientific standing who would tour the country and visit all the scientific laboratories and other institutions at least once a year. They would then be able to come into direct contact with various workers and form first-hand impressions about them. The commission could then make its own recommendations to the Government as to how the most promising people could be best utilised by the State. There would naturally be greater stimulus to effort and achievement if the young scientists are aware that, in addition to their immediate superiors, there is also a big national organisation watching over them; that they have scope

for unlimited encouragement if they can show themselves worthy of it.

Department of Biochemistry,
Indian Institute of Science,
Bangalore, V. SUBRAHMANYAN.
August 2, 1947.

* *Curr. Sci.*, June 1947.

THE FOOD VALUE OF TWO COMMON MOLLUSCS FOUND NEAR PAMBAN AND THE CHEMICAL COMPOSITION OF THEIR SHELLS*

Two varieties of molluscs, Turban shells (*Turbo margaritaceus*) and wedge shells (*Donax cuneatus*) occur on the shores of the Madras Presidency, and their flesh are commonly eaten by fisherfolk when other sea-fish are not available.

TABLE I
Analyses of Mollusc in Madras

Local name (Tamil)	Scientific name	Edibility %	Average size	H_2O %	Proteins %	Fat %	Ash %	P_2O_5 %	CaO %	Iron mgm. 100 gm.
Nathai ..	*Turbo margaritaceus* (Turban shells)	25	3×2 cm.	74·78	17·59	0·25	4·72	0·55	2·69	31·83
Vazhi matti	*Donax cuneatus* (wedge shells)	25	2×1 cm.	76·45	13·13	0·09	4·84	0·40	2·65	32·0

Data on the food value of these edible molluscs are given here. The edible flesh of the molluscs from the shores of the Krusadai Island, were analysed according to A.O.A.C. methods.[1]

Phosphorus (Ammonium Molybdate Volumetric method), Calcium (McCrudden's Permanganate method), and Iron (Elvehjem-Kennedy method), were also estimated.

The figures show that these molluscs compare in food value very favourably with fish, and are richer in Ca and Fe, though somewhat poorer in P. We, therefore, feel that there is sufficient justification for popularising these molluscs as food as good as fish.

The shells of molluscs are sometimes used for making quicklime. An analysis of the shells of these molluscs are given in Table II.

TABLE II
Composition of Shells of Molluscs in Madras
(per cent.)

Particulars	H_2O	Lime as $CaCO_3$	SO_3	Insolubles	Organic matter
Shells of *Turbo* ..	1·00	93·02	0·11	0·237	5·98
Shells of *Donax* ..	0·54	94·83	1·32	0·161	3.17

The high $CaCO_3$ content provides the main sources of a high quality lime. The crushed shells may be utilised as poultry feed because of its high calcium content.

Fisheries Section,
Dept. of Industries and Commerce,
West-Hill, Madras, S. T. CHARI.
March 24, 1947. M. MUKUNDAN UNNY.

* Published with the kind permission of the Director of Industries and Commerce Madras.

1. Methods of Analysis, by the Association of Official Agricultural Chemists, 1945 - Washington.

INTERNATIONAL PHARMACEUTICAL FEDERATION

THE General Assembly of the International Pharmaceutical Federation was held at Zurich on the 25th, 26th and 27th of August 1947. About 250 delegates from various countries attended. The President of the Federation, Dr. Madsen (Copenhagen), presided.

The activities of the first day included the business meeting of the Bureau of the Federation and a meeting of the Directors of Drug Control Laboratories. On the second day, after the Presidential Address by Dr. Madsen, certain matters of special interest to Pharmacy such as International Methods for the Analysis of Pharmaceutical Specialities, were discussed. A proposition to start a new International pharmaceutical periodical the aim of which was "to publish for international information articles which had previously been published in national periodicals only" aroused great interest and discussion. The reason for this proposition was stated to be that "the scientific workers of smaller countries have been at a disadvantage because their publications only reached a limited circle". As an argument against the proposition it was contended that well-established journals would be unwilling to allow their publications to be reproduced. No final decision was taken on this question at the Conference.

Scientific papers that were read and discussed included one on "Some Alkaloid-glycosides", by Dr. Caspari, one on "Local Anaesthetics", by Prof. Buchi, on "Saponins", by Dr. Ruyssen, on "The Polarographic Determination of Morphine", by Dr. Rasmussen, and on "Aromatic Drugs", by Dr. Girardet.

Visits to the Pharmaceutical Department of the E.T.H., Zurich, the Pharmacy of the Zurich Cantonal Hospital and to the laboratories and factories of Ciba, Roche, Sandoz and Geigy at Basel on the 29th constituted other scientific activities, while the social side was catered for by a banquet on the 27th night and an excursion to the Swiss Alps on the 28th.

The Indian Pharmaceutical Association was represented at the Assembly by Dr. S. Rangaswami and Mr. S. B. Rao.

S. RANGASWAMI.

REVIEWS

Infrared and Raman Spectra of Polyatomic Molecules. By Gerhard Herzberg. (D. Van Nostrand Company Inc., New York), 1946. Pp. xiv + 632. Price 50 *sh.*

Prof. Herzberg, whose investigations in the field of molecular spectra are well known, has planned a trilogy dealing with the entire field, and the present book is the second in the series, the first being *Molecular Spectra and Molecular Structure I: Diatomic Molecules* (Prentice Hall, New York, 1939). A further volume on *Electronic Spectra and Electronic Structure of Polyatomic Molecules* is promised. When added to his *Atomic Spectra and Atomic Structure* (Dover Publications, New York, 1944), the series will form an exhaustive source of information on atomic and molecular spectra.

The subject is dealt with in an authoritative and detailed manner characteristic of German scholarship at its best, and the presentation is lucid and illuminating, with numerous illustrations in the best American tradition. The appearance of the book is most opportune since the subject of the spectra of polyatomic molecules is just at that stage where after much spadework by pioneers, a rapid development is being achieved by an increasing army of workers. There is a dearth of completely satisfactory accounts of the field and Prof. Herzberg's books supply the want in an eminently suitable manner. An enthusiastic welcome is, therefore, certain to be received. We can only add that such a welcome is highly deserved. His book on the spectra of diatomic molecules has already become the standard text in the field, and there is no doubt that the present book will take a similar place. We shall, therefore, give an indication of the contents of this work.

After a preliminary chapter dealing with symmetry elements and symmetry operations, the book begins with the theory of rotation spectra taking linear, symmetric top, spherical top and asymmetric top molecules in turn. The next chapter deals with the classical and wave-mechanical treatment of normal vibrations, anharmonicity and isotope effect in great detail. The theory is illustrated by the consideration of infra-red and Raman vibration spectra in the next chapter which also includes a detailed discussion of the spectra of particular molecules. Rotation-vibration spectra, dealt with in the fourth chapter, are particularly well illustrated with photographs, this field being illuminated by the researches of the author and his co-workers. A final chapter on applications includes sections on the calculation of thermodynamic quantities and the nature of liquid and solid states. The discussion in this last section is so inviting that one regrets that Prof. Herzberg has not added his critical appraisement of a number of researches whose results were somewhat of a controversial character; but possibly a book is not the best place to deal with controversial matters.

Although there are some very good books dealing with Raman Spectra, the author's presentation gains in value by the sure touch of a teacher's instinct with which Prof. Herzberg has chosen the best treatment and the thorough manner in which classical theory and its wave-mechanical modification and improvement are consistently blended from the beginning to the end of the book. The number of diagrams and tables is large—we may say lavish—even by American standards. The immense material surveyed, digested and critically served up for the reader's edification can be gauged by the list of 29 books and 1,055 original papers given in the bibliography, and the subject index running to 65 pages makes all this material available for selection at a moment's notice. The book thus provides immense help and counsel to anyone who wants to get acquainted with this rather intricate and difficult field. The appreciation here attempted is a result of a sense of having had an urgent want well supplied and a conviction that a similar sense of thankfulness is bound to arise in the mind of every reader who turns to this book for instruction and guidance. Prof. Herzberg can very well have the satisfaction of having completed a particularly useful and difficult task in a manner calculated to earn the gratitude of a large number of readers. The fame of the publishers is a guarantee to the excellence of the typography and binding, although the present reprint has had to eschew the use of the best paper on account of war economy. The book is an indispensable addition and ornament to the library of every spectroscopist and an inexhaustible mine of information to every research worker in this subject. We extend to it a hearty welcome and eagerly look forward to the promised volume which is to complete the trilogy.

T. S. SUBBARAYA.

Fundamental Principles and Applications of Induction Heating. *"Heat Treater"*, (Chapman and Hall, Ltd.), 1947. Pp. 145. 10*s.* 6*d.*

High frequency induction furnaces have from their inception rendered important assistance to scientific investigators handling high purity metallic products at temperatures beyond the reach of more conventional furnaces. Commercially, high frequency induction melting has been used to a limited extent in the production of valuable materials such as permalloy and nickel-chromium alloys. During the past few years, however, much attention has been directed, to the use of high ferquency induction (or eddy) currents for the heat-treatment of fabricated or partly fabricated products.

In his book, *Fundamental Principles and Applications of Induction Heating*, the author is concerned mainly with the thermal treatment of solid materials. Ordinary melting operations are outside the scope of this book although some processes are described in which localised melting is conducted under strictly controlled conditions. After a very brief histori-

cal introduction to the subject of high frequency induction heating, reference is made to some of its modern applications which are quickly, cheaply, conveniently conducted and result in a better product. The distinction is drawn between induction and dielectric heating. The author emphasises that a full mathematical treatment is omitted and that the simplified formulæ given in the book should only be used as a basis for coil design. It is evident to the reviewer that caution is necessary in the use of the equation (page 28) which indicates that the power dissipated in the surface layers of a specimen—varies as the square root of the resistivity. In the extreme case this leads to the absurdity that the maximum amount of heat would be generated by induction in an insulating or semi-insulating material. Further, the formula ignores the reactance of the eddy current circuit. Mathematical treatment is difficult because electrical resistivity, thermal conductivity, specific heat and possibly magnetic permeability change during the process of heating. It is, therefore, not surprising that the author states that final details for a particular heating operation are invariably determined by trial and error.

Many interesting drawings are given, depicting single and multi-turn inductor coils intended for heating special zones of variously shaped metallic specimens. The process can be applied to the interior surfaces of hollow samples. The choice of frequency (for the current in the inductor coil) is discussed, and although not critical, due regard must be given to the size of the sample and the desired thickness (or penetration) of the heated zone. This is followed by a brief review of the three types of generators commonly in use—namely, motor generators, spark gap generators and thermionic valve oscillators.

It is considered by the reviewer that a little attention should be given to this section of the book in order to bring the whole work to a uniformly excellent standard. For example an ordinary commercial step-up transformer cannot be used in the spark gap generator, as stated by the author (page 52), unless chokes are provided. Again in Fig. 34 the secondary winding of the step-up transformer is shown metallically connected to the heating coil. It is easy and customary to isolate the heating or operating coil from high voltages at mains frequency by interposing condenser units. The function of the induction coil in this diagram is mysterious. What is probably intended is some form of step-down transformer intended to feed the operating coil with heavy currents at low voltage.

Regarding valve oscillators, the two sample oscillators shown in Figs. 37 and 38 are hardly suitable for commercial operation since in both cases the magnitude of the oscillations depend greatly on the loading of the operating coil. Thus, it is possible in some instances to completely suppress the oscillations by inserting ferromagnetic material into the field of the oscillating coil. One remedy is to construct an oscillator comprising a master oscillator driving the power valve which supplies the energy for the operating coil.

The largest section of the book is devoted to the hardening of steel by induction heating and quenching. Often quite localised hardening is required, and this must be done with the minimum distortion to the specimen. Induction heating, owing to its ease of control, is peculiarly suited for this operation. Further, it is claimed that harder wearing surfaces are obtained by inductive heating and quenching than by other methods. Of the many examples given, two may be mentioned. A localised hard bearing surface can readily be produced on the inside cylindrical surface of motor car wheel hub. Gear wheel teeth can be surface-hardened leaving the interior of the teeth and the body of the wheel in a moderately soft and tough condition. Induction heating is not only suitable for repetition work involving surface-hardening but can also be applied economically to welding (including carbide tops on tools) brazing and soldering processes. Notable among the miscellaneous applications is the flowing of electro-deposited tin coatings. This permits a saving in tin since a more uniform and less porous layer of tin is produced. It is impossible in a few words to do justice to the latter portion of the book which presents in a convenient form a mass of information much of which has appeared from time to time—scattered—in various recent publications.

The writer is undoubtedly an expert in the practical application of induction heating and his authoritative book is indispensable to anyone interested in this rapidly expanding art.

FRANK ADCOCK.

The Chemical Constitution of Natural Fats. By T. P. Hilditch. (Chapman and Hall, Ltd., London), 1947. Second Edition. Pp. 554. Price 45 *sh.* net.

Fats form a very important class of organic compounds both from industrial and nutritional point of view. A systematic examination of their chemical composition may be said to have begun with the present century. On account of the complexity of composition of fats, the chemist at one time was content with the determination of a few constants. It is only as a result of painstaking work and new techniques evolved during the last decade it has been possible to determine the detailed composition of such a complex group of substances with relative ease, thus enabling us not only to study them but also predict their composition with a reasonable degree of accuracy having known their origin. This achievement is in no small measure due to the inspiring and untiring work of Prof. T. P. Hilditch and his colleagues at the University of Liverpool, which has now become an international centre for research on fats and allied subjects.

The second edition of the book under review has appeared within a period of seven years, and considering the present conditions in Great Britain, under which this must have been compiled, the author and the publishers deserve to be congratulated. The book is a unique contribution to our knowledge of chemistry of natural fats, and all the more valuable as it is written by one who has made the study of fats his life-work. This new edition, like its predecessor, has been divided into eleven chapters, and almost every page has been revised to bring

our knowledge up to date. The book contains extensive bibliography and is well indexed. The law of even distribution of fatty acids in glyceride molecules has been explained in detail and applied with success to predict the composition of fats of the same group. Notable new additions include composition of the body-fats of marine teleostid fish; component acids of depot fats of rats on low and high fat diets; composition of depot glycerides of Indian ox and buffalo and the effect of climatic conditions; composition of the body-fats of lion, puma, tiger, cat, baboon and man; component acids of blood lipids. The chapter on milk fats has been revised to include data on the effect of food, season and species on its composition. Further data on different seed fats, detailed description of the technique for the separation of mixed fatty acids by crystallisation at low temperatures, and computation of proportion of the chief component glycerides of a fat from its fatty acid composition, have also been added.

Throughout the book the position of the unsaturated linkage has been denoted by reference to the first C atom, instead of both (*i.e.*, oleic acid as C^{9} instead of $C^{9\ 10}$) as is the usual practice to-day. This conveys the required meaning without any ambiguity, saves space and is more pleasant to read. One minor correction may be pointed out. On page 112 the Reichert Value has been described as Reichert-Meissl Value in spite of the recommendation in the B.S.S. No. 769-1938. The range of variation of the Reichert Value of cow butter-fat should be more appropriately 23-36.

NOSHIR N. DASTUR.

The First Brochure of the Chronicle of the World Health Organisation, Geneva, 1947 (Vol. 1, No. 1).

The Journal under review is one that deals with the aims, the constitution and functions of the Organisation.

This Organisation though of recent inception has taken upon itself a very laudable but supremely tremendous task of viewing health problems from international standpoint. It is very rightly stated that 'disease knows no frontiers, and anything less than world action may not only deprive one nation of the benefits of the Organisation, but may endanger the health of all member States'.

The activities of the Organisation are 'various, widespread and complex'. 'They affect not only governments and public health administrators but practitioners in many fields of medicine and hence certain aspects of the lives of individual citizens. . The declaration contained in the preamble to its constitution, *viz.*, 'the enjoyment of the highest attainable *standard* of health is one of the fundamental rights of every human being' is its ultimate goal. The concept of health is wide and comprehensive. The Organisation rightly holds that 'health is a state of *complete* physical, mental and social well-being and not merely the absence of disease or infirmity'. Besides it holds that 'the health of all peoples is fundamental to the attainment of *peace and security*'. (Both these, alas! being totally shattered by the Great War and its aftermath.)

The Organisation proposes to achieve its object by (1) co-operation, (2) co-ordination, (3) propaganda, (4) dissemination of comparative statistical records, discussions, suggestions and topics of interest by publication of leaflets and brochures apart from the *Chronicle of W.H.O.*, (5) research work, (6) finansial aid, (7) conventions and (8) expert advice.

To us particularly, in Independent India, this effort ought to be very welcome indeed. For, too long have we suffered from ill-health, misery and bondage, too long have the poor ratepayers' moneys gone elsewhere and utilised for purposes other than the amelioration of living conditions of the mass of people, too long have we borne patiently all these, and now free India should certainly brace up and consider the health of the people of the nation as its first charge. In this connection the World Health Organisation is bound to be of immeasurable help. It is to be earnestly hoped that India will wholeheartedly co-operate and reap the full benefit. At present the offices of the Organisation are at 350, Fifth Avenue, New York.

K. R. RAMASWAMY.

The Relation of Diseases in the Lower Animals to Human Welfare. (*Annals of the New York Academy of Sciences*, Vol. 48), 1947. Pp. 226.

This is a symposium which embodies nine excellent papers presented at a conference on the subject, held by the Section of Biology of the New York Academy of Sciences, on March 15 and 16, 1946. The subjects dealt with, *viz.*, rabies, equine encephalomyelitis, psittacosis, brucellosis, plague, tuberculosis, anthrax, *Erysipelothrix rhusiopathiæ* infection and animal parasites transmissable to man vitally concern human welfare and have been handled by experts who have devoted considerable study and thought to the respective branch of study. Up-to-date information has been given on each subject, with a masterly historical perspective. The volume is heralded with an apt introduction by Dr. W. A. Hagan who attempted to bring home to the public the enormous loss caused by various parasites in the United States of America and indicated the manner in which these could be transmitted from lower animals to man. The publication of this number has fulfilled a long-felt want of collated information on several important subjects, and it will be useful to the people belonging to the medical profession, to veterinarians, public health workers and students of biology in general.

G. D. BHALERAO.

PUBLICATIONS RECEIVED

1. *All Necessary Water can be Synthesized within the Plants.* By Nandlal Sharma, Ex-Principal and Research Scholar, P.O. Khamgaon (Berar).

2. *Bihar's Mineral Wealth and Industries.* By W. D. West. (A popular lecture delivered on the occasion of the First Anniversary of the Geology Department, Patna University, on April 25, 1947.)

Carnegie Institution of Washington—Year-Book, No. 45, 1945-46.

SCIENCE NOTES AND NEWS

Research Grants

A meeting of the Governing Body of the Council of Industrial and Scientific Research was held at New Delhi on August 25. Pandit Jawaharlal Nehru, Prime Minister of India, presided.

The Council sanctioned schemes of research involving a total expenditure of Rs. 83,700.

It was decided to establish a National Internal Combustion Engineering Laboratory, and to send abroad fifteen students for advanced study and training in internal combustion engineering in order to meet the needs of the National Laboratory, Industries and Technological Institutes.

The Council also recommended a grant of Rs. 2·25 lakhs to the Indian Institute of Science, Bangalore, for the training of personnel in internal combustion engines and for long-range research in the field. The setting up of an Indian Aircraft Establishment, and Admiralty Establishment and an Internal Combustion Engine Development Board was recommended by the Council.

The Council decided to bring out a monograph on Indian medicinal plants and a popular edition of the monograph on aromatic plants of India.

A grant of Rs. 3 lakhs was sanctioned for the Research Institute of the Indian Academy of Sciences, Bangalore, for physical and chemical investigations of the minerals of India under the direction of Sir C. V. Raman.

Dr. Shyamaprasad Mookherjee was elected Vice-President of the Council.

Indian Institute of Science

The Council of the Indian Institute of Science approved, at a meeting on the 8th September, a large building programme for housing laboratories of power engineering, high-voltage engineering, pharmacology, fermentation technology and food technology.

The Council also recommended to the Visitor the appointment of Dr. B. Sanjiva Rao to the post of Nizam Professor of Inorganic and Mineral Chemistry at the Institute.

Unesco Projects for India

It is reported that in the very near future UNESCO will undertake publication of scientific journals in Indian languages, probably from Calcutta, for the purpose of disseminating the results of the latest scientific research from all parts of the world to the Indian public. To begin with, the Journals will come out in Bengali and Hindi, and later it may be published in other Indian languages.

Some of the Most Important Advances in Science in 1946

Science Service of Washington, D. C., lists (1) Distribution of radioactive isotope varieties of common chemical elements, made in chain-reacting atomic pile, for research and medical use; (2) Synthesis of penicillin and of vitamin A; (3) Revelation of biological warfare developments, including vaccine against rinderpest, and isolation of botulinus toxin; (4) Production of anti-malarials, chloroquin, declared better than atabrine and quinine, and pentaquine, believed positive cure for vivax malaria; (5) First births of animals from foster-mothers into which were transplanted ovaries from other animals.

Substitute for Jute

The South African Government has announced that all details for the cultivation of "wilde stokroos" (wild hollyhock) and the establishment of South Africa's first factory for manufacture of bags from fibre has been settled.

Wilde stokroos will be planted in the low veld of the Transvaal for the time being. Nelspruit has been chosen as the site of the factory.

Records of the Indian Museum

The Records of the Indian Museum, a Journal of Indian Zoology, which was suspended in 1942, was received last year, and Part IV of Volume XLIV appeared in December 1946. The next issue is expected to be published shortly. The Journal will be a quarterly as hithertofore.

A Reaper for Indian Farms

Mr. R. Venkata Ramaiah, a scholar deputed to the Iowa State College for specialisation in Agricultural Engineering, has devised a mechanical reaper of simple construction suitable for use on small holdings in India. The design can be built in Indian workshops at a cost of about Rs. 300, and is capable of reaping 4½ to 6 acres in a ten-hour day.

Sir C. V. Raman

The World Bank Advisory Council has recommended that nine persons representing various international industrial, scientific and agricultural organisations be selected to form the Advisory Council of the Bank to serve as Councillors for a period of two years. They have included Sir C. V. Raman of India, and S. K. Alfred Sze of China.

Dr. S. R. Palit

Dr. S. R. Palit has been elected Fellow of the Royal Institute of Chemistry of Great Britain and Ireland on the merit of his published researches.

ERRATA

Vol. 16, No. 7, July 1947, p. 225: "Formation of Complex Compounds ..." Under References on p. 226, *omit* "Mathur".

Vol. 16, No. 8, August 1947, p. 257: *Read* Fig. 1 as Fig. 2 and *vice versa*.

Same page: In second column, para 3, *read* (Fig. 2) at the end of the sentence "The accompanying figure will give an idea of the distribution of *Fusarium* during different months of the year."

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INDUSTRIAL RESEARCH ASSOCIATIONS

THE indispensability of uninterrupted basic and applied research in every branch of industry has made Industrial Research Associations a unique and progressive feature in the industrial economy of Great Britain. The work of the Associations consists of the application of scientific knowledge to the processes operated with a view to establishing the fundamental causes of their success and to devising improved methods of production. An additional function of the Association is the sifting of the technical and scientific literature published and the dissemination of the relevant material to industrialists. Unlike in America where large-scale manufacturers and combines, like the Duponts and the General Electrics and the Mercks, have their own well-equipped laboratories, in Britain the Research Association seeks to achieve similar progress through research and application of science by means of co-operative effort. The origin, organisation, function and benefits accruing from the Research Associations were explained by Sir Edward Appleton in a speech delivered by him before the British industrialists.

"I am convinced," said Sir Edward, "that the most valuable support that can be given to industry in meeting its particular needs for scientific knowledge, both for immediate application and for its long-term requirements, lies in the encouragement of co-operative action through the Research Associations. Remember that although Government through the Department of Scientific and Industrial Research contributes generously to the Research Associations, they are mainly financed by their member-firms and are self-governing organizations. They ought, therefore, to be well fitted for knowing the problems facing their industries and for carrying out the type of work most likely to be fruitful. If they fail in this the fault lies with their members and not with Government.

"Apart from the research they carry out, the Research Associations form centres of information and advice to their members for dealing with their day-to-day difficulties. This, together with the rights of members to propose items for investigation, to have the use of patents taken out, to submit problems for solution and to consult the Associations whenever they wish, has convinced us in the Department of Scientific and Industrial Research that the Research Associations' scheme provides the best single method

of bringing research and scientific knowledge within the reach of smaller firms.

"With the 31 Research Associations already formed, and with the others in course of formation, the main industries of the country such as textiles, metals, rubber, paint and pottery and so on are well covered, together with a number of the processing industries such as welding, packaging and production engineering.

"Cases arise of course, for example, in general engineering, where a firm's needs are not covered by a single Research Association and where it is necessary for it to join several. This would certainly be a difficulty, if the cost of joining a Research Association were not so low. A medium-sized or small firm can, however, join a number of Research Associations for a sum less than the salary of a single young scientific worker; and for this small expenditure the results of research costing many tens of thousands a year becomes available to the firm. Money should not, therefore, be a deterrent.

Commercial Competition and Co-operative Research

"Many branches—the engineering industry for instance—are keenly competitive. How then do they stand in relation to co-operative research? I can quite understand the anxiety of these competitive industries that the products of the skill of their designers and engineers should remain the closest secret until full production has been achieved That kind of competition often provides a real incentive to progress; but for the life of me I cannot see that there is any benefit whatever in each individual manufacturing concern itself, attempting to carry out the basic research which must form the stock of scientific knowledge upon which the whole industry must depend for its progress. In my opinion much of that kind of work can be much better done co-operatively.

"A brief glance at some of the items of the programmes of the Research Associations will illustrate what I mean. The Motor Research Association, for instance, is carrying out work, using the most up-to-date physical equipment, on the filtration of lubricating oils and its effect upon wear. It is studying the performance of bearings and bearing materials and the durability of gears. The Internal Combustion Engine is investigating similar problems in its field, and in the course of its work many different materials are carefully studied. This Research Association is also carefully investigating several German engines of novel design to see what can be learnt of value to our industry. The Production Engineering Research Associations are carrying out fundamental work on the processes of drilling, turning and milling, on surface finish, on the performance of lathe tools and on methods of testing various types of machine tools. Work such as this, which is fundamental to the whole of industry, must be carried out well. It seems to me that it can be done most economically and efficiently in co-operative laboratories."

This account of the Research Associations by Sir Edward Appleton can easily serve as an example that could be copied in this country with benefit. The conditions prevailing in our industrial system are, to a very great degree, similar to those of Britain. There are in India, for instance, numerous small concerns, who, while anxious to encourage research in their respective fields, lack the wherewithal to maintain even a modest laboratory. These firms could join together to form Research Associations which are sure to step up their progress and, therefore, the pace of industrialisation of the country. The All-India Manufacturers' Organisation is at present best suited to sponsor such a move among the major, well-established industries in India. The Silk Research Association, for instance, will include mulberry growers, cocoon makers, silk reelers, throwers, weavers, spun and waste-silk manufacturers, dyers and silk machinery makers. Similarly cotton, wool, jute, metals, rubber, sugar, oil seeds and other interests will derive immense benefit by becoming actively research-minded. In their attempts to help themselves the Council of Scientific and Industrial Research will, needless to say, be only too eager to help them both with finance and their valuable advice and experience in the various branches of industry. It is time that the planners and executors of the vast schemes of industrialisation of the country recognised that, with the logarithmic rate of scientific and technical progress all over the world, it is a huge folly to establish any large-scale industry without the backing of an efficient machinery of research that would help discover new uses for and adopt the latest advances in the exploitation of our natural resources. We trust the enlightened industrialists of the land will not fail to come forward with practical proposals to incorporate research activity as an organic part of the industrial plan that is being contemplated for India.

OBITUARY

Prof. MAX PLANCK

THE death of Prof. Max Planck at Göttingen on Saturday, the 4th October, removes from the scientific world a unique genius whose labours laid the foundation of modern physics. Although at the time of his death Prof. Planck was more full of years and honours than the common run of humanity, a sense of regret still abides with us that we can no longer hope to hear any more words of wisdom from his lips. The following has been written with a sense of duty to the great departed that every student of science owes—a duty to remember with reverence the great heritage of knowledge left behind by a master mind.

The workings of a unique intelligence are as inscrutable as the ways of Providence. When we contemplate how the law of distribution of energy in the spectrum of a black body (seen by Lord Kelvin as a small cloud no bigger than a *man's fist arising on the fair horizon of classical physics*) has grown, not into an obscuring blackness covering the world, but into a fairyland full of beauty and promise, we are struck with wonder at the shortness of time in which this has come to pass. But our wonder grows into amazement when we try to remember how all this has been made possible by the work of a genius who found a path which no one else could see and who trod it with faith and firmness till the land of promise was revealed. *For, the basic idea of the quantum theory* was not only revolutionary but it was attained by a circuitous path. The same blaze of intuition which led Einstein to see in the Michelson-Morley experiment a challenge to our usual conception of absolute time, led Planck inevitably to see in the law of black body radiation the death blow to the usual conception of the infinite divisibility of energy. Both the subtlety and the certainty of these two intuitions cannot be matched in the history of physics: *they are unique examples to ponder over* with humility and wonder.

That Planck's father was a legal luminary, being Professor of Constitutional Law at Kiel and Göttingen and joint author of the *Prussian Civil Code* may or may not be significant, but that Planck's teachers were such men as Helmholtz, Kirchhoff and Weirstrass, is certainly of importance for the flowering of his genius. Born at Kiel on the 23rd of April 1858, Planck studied at Munich and Berlin and obtained his doctorate with honours in 1879. His thesis on the Second Law of Thermodynamics, and his studies were certainly influenced by the discoveries and teaching of Kirchhoff who had shown that the radiation from a black body was independent of its internal constitution. In 1880 Planck became a tutor (Privatdozent) at Munich, and five years later he was made a Professor of Physics at Kiel. In 1889 Kirchhoff died and his place was taken by Planck as Extraordinary Professor and later in 1892 as full Professor in the University of Berlin. Here he remained for the rest of his teaching career, refusing in 1907 an invitation to succeed Boltzmann as Professor of Physics at Vienna. In 1912 he was made permanent Secretary of the Prussian Academy of Sciences to which he had been previously elected in 1894. In 1913-14 he was Rector of Berlin University, and in 1918 he was awarded the Nobel Prize for Physics. He became an Emeritus Professor in 1926 when Schrödinger succeeded him at Berlin. In the same year he was elected a Foreign Member of the Royal Society and received the Copley Medal in 1929. He was elected in 1930 President of the Kaiser Wilhelm Gesellschaft, but resigned from this office in 1938 in consequence of his political views which were anti-Nazi.

Prof. Planck had his tribulations no less than ordinary men. He lost a promising son in the first World War, and two of his married daughters died prematurely. His first wife, Marie Merck, whom he married in 1887, died after giving birth to two sons and two daughters. In 1911 he married his second wife, Margaret von Hösslin, and became the father of another son. As against some of his sorrows, he saw one of his sons become a high official in the von Papen Government. But if we look at his portrait, we see a benevolent countenance saddened by life's trials, but with still a twinkle lurking in the good-humoured eyes. A great man unspoilt by success and full of faith in the future—that is how his likeness strikes us.

The great theory associated with his name—the quantum theory—arose logically from his early researches in Thermodynamics, but the logic is too deep for ordinary minds to have developed the theory. Whereas Einstein's theory of the photoelectric effect seems to make the quantum idea obvious and inevitable, the reasoning which led Planck to enunciate his theory to a startled audience is recondite and remote. Experimenters like Zummer and Pringshiem, Rubens and Kurlbaum had studied the energy associated with the various radiations emitted by a black body; and two great theorists, Wien and Rayleigh, had propounded two theories leading to different formulas, one of which agreed with experimental results in the region of short wavelengths, while the other represented the long wavelength region correctly, but neither formula could represent the whole range. It seems as if one could combine the two formulas in some way so as to describe the whole of the experimental results, but the correct modification found by Planck is not at all obvious. Planck was studying a rather obscure quantity which he encountered when applying Boltzman's ideas about entropy to the field of radiation, and he calculated this quantity from the formulas of Wien and Rayleigh. He then combined the two expressions so obtained for this elusive quantity and, working back, arrived at his famous Law of Radiation which was entirely in accord with experiment throughout the range of wavelengths studied. This in itself was an achievement, but Planck capped it by developing a theory to derive his formula, and

here he enunciated the fundamentally new doctrine that energy is emitted in discrete amounts called quanta. He also showed that the quantum is proportional to the frequency, the constant of proportionality being the remarkable quantum of action, h, since famous as Planck's constant. The successive researches of Einstein (Theory of the photoelectric effect, 1905), Bohr (Theory of the hydrogen spectrum, 1913), Compton (1922), Raman (1928), Heisenberg (The Uncertainty Principle, 1927), have only proved how this constant pervades the whole of atomic physics. His part in these later researches was more that of the master rejoicing in the adventures of younger minds, constantly counselling them not to go astray, rather than that of active participation. But when some exaggerated speculations of a philosophical character were based on the uncertainty principle, Planck asserted his individual opinion and, together with Einstein, supported the principle of Causality. As a teacher he is well remembered for his text-books, particularly those on Heat and Thermodynamics, which have been translated into various languages.

The minute attention to detail exhibited in the enunciation of his radiation formula and the happy faculty of making a grand generalization shown in the theory developed to explain the formula were characteristic of his spirit. The presence of artistic ability thus indirectly exhibited was even more evident because of his musical talent, a characteristic common to many other great scientists including Einstein. A kind of religious spirit with which scientific investigations were carried out also contributed to the feeling of respect which he inspired in his scientific colleagues. In fact Prof. Planck himself has unconsciously revealed the essence of his spirit in some remarks he made about Sommerfeld on the occasion of the latter's seventieth birthday. We shall, therefore, close this expression of homage to a great soul by giving a translation of his sentiments regarding another great colleague. This is what he said:

"But a careful observer cannot fail to notice that in Sommerfeld's genius there is, besides a dispassionate feeling for mathematical correctness and physical reality, another motive which has its origin in a remoter region and has an æsthetic basis and which is encountered in fertile geniuses of all ages from Pythogaras to Bohr: it is the incentive due to that mysterious harmony and completeness of the picture, which the ever forward-groping fancy of the investigator discloses when he tries to fit his thought to the data furnished by Nature. Those laws which, like those of the anomalous Zeeman Effect, have not yet been completely explained are essentially the ones calculated to incite such flights of genius."

T. S. SUBBARAYA.

FUTURE OF INDIAN SILK INDUSTRY

THE Silk Panel appointed by the Government of India holds the view that consolidation rather than expansion is the immediate need of the silk industry in India. It has recommended a five-year programme of stabilisation of the silk industry in India preliminary to a phase of expansion during the next two quinquennia.

Demand for silk generally and for filature silk especially being high in war time, there was then a considerable step-up in production under Government encouragement. Thus between 1939-40 and 1945-46 the number of filature basins rose from 1,291 to 4,639, and the area of mulberry cultivation rose from 30,000 to 78,000 acres in Mysore, from 5,720 to 18,026 acres in Madras and from 8,983 to 15,516 acres in Bengal.

But the Panel warns that if the industry thus developed by State assistance as part of war efforts is now left unsupported, it may collapse, and with it an important source of India's war strength.

Incidentally, the Panel has made a separate recommendation that Japanese silk entering India by way of reparations should not be allowed to undersell Indian silk.

The Panel has recommended consolidation and improvement of the present position of the industry along a number of lines. For the improvement of mulberry cultivation, it recommends the five-year sericultural programme adopted by the Government of Madras to other silk-producing regions, *viz.*, Kashmir, Mysore, Bengal, Bihar, Bombay and C.P. While pointing out the need for effective State control to ensure adequate supply of disease-free seeds, it foresees the need for 300 fully-equipped grainages, costing Rs. 20,000 each, to meet the total requirement of India, which will be about 12 crores of layings. To control silk-worm diseases, the Panel adds, there should be in each silk-producing region a special enactment as in Mysore.

ULTIMATE TARGET OF PRODUCTION

In order to have the charkhas replaced by the filatures, a change on which rests the hope of the silk industry in India, the Panel recommends the setting up of co-operative societies on lines suited to local circumstances. It also pleads for authoritative establishment of definite standards conforming to accepted international grading. It emphasises co-operation among the various silk-producing areas in the country and recommends the establishment of a Central Silk Board representing all silk interests.

In the next five years, says the Panel, 49,868 acres more or 1,62,500 acres in all will be under mulberry cultivation and this will increase to a total area of not more than 1,87,500 acres (excluding Kashmir) in the 3rd quinquennium. Including the increase of 50 per cent. in the production of silk in Kashmir, the Panel does not foresee all-India production to be more than 4 million lbs. per annum at the end of 15 years, the annual consumption being estimated at 15 million lbs.

THE INDIAN BREWERY TRADE

K. S. RANGAPPA
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MOST Indians are, by custom and practice, teetotallers; and alcohol consumption is confined to a small section of the working classes, these spirits being largely derived from the palm trees (*Phœnix sylvestris*, *Cocos nucifera*, *Nipa fructicans* and *Borasus flabelliformis*). The National Government, now in power, with its natural solicitude for the welfare of the masses, is taking steps to eradicate this evil. It won't be much of a prophesy if we state that India will succeed in this reform where other countries have failed. At the present speed of progress it will hardly be a few years before the whole country is dry. But the uprooting of an age-long, deep-rooted social evil naturally causes, in the initial stages, great dislocation and upheavals in the social strata.

Toddy brewing is quite an ancient industry in India. This, like all ancient professions in the country, has created its own hereditary class of toddy-tappers and brewers, uninterested in any other profession. The sudden and total extinction of the trade has, therefore, caused great hardship to all who live by this trade. And the sponsors of the reform are now hard put to it to find an acceptable alternative profession for these men. Many of these difficulties could have been avoided if scientists had been taken into the confidence of statesmen and legislators. Even now it is to be hoped that rational steps will be taken in rehabilitating people unemployed as a result of this salutary reform and that the raw material of this industry will be utilised for productive purposes.

An impression appears to prevail among the public that the palms from which toddy is tapped is good for little else. This is not necessarily so. The sap of the tree, from which toddy is fermented, contains a high percentage of sugar[1] (10-16 per cent. depending on the specie) and vitamins. It stands to reason that the sweet fluid could be commercially exploited as a source material, even as cane juice, for "palm sugar". The juice of the nipa palm is almost equal in saccharine richness to cane juice, with the advantage that it is much cleaner and contains no colouring matter nor chlorophyll; the vegetable matter being easily precipitated, gives a liquor as clear as spring water. With the successful elimination of the rather high saline content of the juice it must be possible to produce sugar from this source on a competitive basis. Of date-palm sugar we know that the yield per acre is definitely higher than of cane, and it costs so little to grow these palms which have an average yielding life of 30 years.[1] In fact, manufacture of "palm jaggery" (Gur) containing about 60 per cent. of sucrose and 15 percent. of fructose[3] is a cottage industry in some parts of the country. Annually, 100,000 tons of the jaggery are produced in Bengal, and about 40,000 tons in Madras.[2] Some factories in South India have been refining palm-jaggery for years on a commercial scale. Now it is but a step to turn over all the sweet-palm sap that was being fermented into toddy for the manufacture of refined sugar. And the sugar from this source is likely to make no mean contribution to the country's supply in this commodity. For, each tree yields about 37 lb. of sugar per year; and assuming 350 trees per acre, this would mean 3·6 long tons of sugar, which is not much less than the production (about 4 tons per acre) from sugar-cane.[1] The existing area of about 200,000 acres covered by palm[3] has, therefore, a potential capacity of yielding 600,000 tons of sugar, *i.e.*, a valuable 10 per cent. extra production of the nation's sugar supply.

It must also be possible for technical processes to be developed for producing power alcohol from the palm juice or jaggery or the residue (corresponding to cane molasses) from refined palm sugar. As an indispensable part of the defence needs of the country—we have no natural resources of oil or gas—it is the essence of statesmanship to cultivate all sources of power even if it cannot quite compete with imported oil in normal times. Palm juice can also provide the basic material for the production of food yeast and essential vitamins both of which could well supplement the present meagre supply. The unfermented sap is claimed, by the indigenous systems of medicine, to be a cure and health-giving tonic for certain diseases. And it is known that it is a good diuretic. Pharmacology might evaluate its precise medicinal worth and press it into service if found useful. Well planned and well exploited, it should be possible not only to face successfully the present crisis of unemployment and dislocation, but establish new and productive industries on the gravestone of the Giant Evil that was Drink.

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1. Heriot, "Manufacture of Sugar," 1920, p. 30, Longmans Green & Co., Lond. 2. Gandhi, M. P., The Indian Sugar Industry (Annual), 1939, p. 189. 3. The Indian Year Book, 1947, p. 328 (Times of India Press).

SUPERSONIC VIBRATIONS—A NEW DETERGENT

The washing of materials with high-frequency vibrations instead of with soap and boiling water has been accomplished by the British Launderers' Association Laboratories. Most of the dirt molecules adhering to fabrics are negatively charged; and generally speaking, electrical forces can be held responsible for this adhesion. Supersonic vibrations applied *via* a quartz reproducer to a soiled fabric immersed in water or other medium shakes out the dirt, the vibrations being strong enough to overcome the electric adhesion of the dirt molecules. Experimental test-pieces of soiled fabric, it is said, have been vibrated clean within ten minutes. The apparatus, however, is still in the experimental stage.

VARIATIONS IN THE SEASONAL COMPOSITION OF THE PHYTOPLANKTON OF BOMBAY HARBOUR

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THE plankton of Bombay Harbour has been studied by Bal and Pradhan,[1] but their work deals mainly with the zooplankton. This investigation is concerned with the phytoplankton of their collections, which were made regularly twice a week from July 1944 till August 1946. A rough estimate of the number of forms was obtained by the method of Lebour. A fixed quantity of water was centrifuged, and symbols such as cc, c, +, r, and rr, were given to species according as 30 or more, 20 to 29, 10 to 19, 2 to 5 or 1 were present in the sample. This method, though not very accurate, gives a fair idea of the seasonal abundance of the phytoplankton.

The phytoplankton consisted chiefly of Diatoms and Peridinians. In all 54 genera and 126 species of Diatoms and 13 genera and 34 species of Peridinians were recorded. Subrahmanyan[2] has recorded 171 forms of Diatoms from the Madras coast, while in previous studies the maximum number recorded has been 41 species of Diatoms and about 20 species of Peridinians from the Trivandrum coast by Menon.[3] The number of Diatoms recorded in Bombay is not as many as in Madras, the reason probably being that the area of collection was restricted in this investigtion to Bombay Harbour alone. The number of Peridinians observed here is considerably more than that of previous workers.

The genera which were seen in fairly large numbers in most of the collections (except those of the monsoon) were *Chætoceros* (24 species), *Coscinodiscus* (13 species), *Biddulphia* (7 species) and *Bacteriastrum* (6 species). Occasionally swarms of *Ditylium* and *Corethron* occurred in August and November respectively; but these were more of the nature of ephemerals, as they also disappeared suddenly. Of the pennate diatoms *Pleurosigma* (7 species) and *Nitzschia* (5 species) were common.

From the beginning till the middle of the rainy season, *i.e.*, from June to August, the plankton collections were very poor. A number of filaments of *Trichodesmium* were observed at this time. Due to the winds, a considerable disturbance was created in the sea and the water was mixed over a great depth. Towards the beginning of September, there was a sudden increase in the number of Diatoms and by the end of September, fairly good collections were obtained. From September onwards, Diatoms steadily increased in number, till the maximum was reached in the month of January and beginning of February. After this, their number decreased steadily till May. In May, however, a number of pennate Diatoms, probably mud-inhabiting forms brought up through disturbance of the waters by the strong winds of the south-west monsoon, occurred. Few Peridinians were seen during the monsoon and appreciable numbers were only recorded in the middle of October. Their maximum, however, was attained rapidly in the third week of December. They could never vie with the Diatoms in quantity, and even during their periods of maximum abundance, the Diatoms far outnumbered them. They seemed to favour the early part of the cold season, while the Diatoms seemed to prefer the latter half of the same season.

The following summary of the occurrence and seasonal variations of some of the more important genera will afford a comprehensive idea of the occurrence of the phytoplankton as a whole:—

Sceletonema: It occurred in September, rapidly increased in number, and was fairly common at the end of September and October. Thereafter its numbers decreased, and though seen till February, it was never common after October.

Thalassiosira: Towards the end of January 1945, *Thalassiosira subtilis* (Ostenfeld) Gran.—never observed before this—occurred in small numbers. In the first week of February, heaps of these delicate forms embedded in mucilage were seen. In the latter half of February, the number decreased, and by March, it had disappeared. In the following year, 1946, it occurred occasionally and never in large numbers.

Coscinodiscus: During the monsoons, this genus was represented by a few specimens. In September, it gradually increased in numbers and by the end of October, it was common. The best represented species were *C. concinnus* W. Smith, *C. radiatus* Ehr., *C. lineatus* Ehr., and *C. centralis* Ehr. By the middle of November, *C. concinnus* W. Smith was abundant. It decreased slightly in number subsequently, but in January it had a second rise. *C. centralis* Ehr. showed a steady increase from September till it reached its maximum in March. *C. radiatus* Ehr. and *C. lineatus* Ehr. were seen in appreciable numbers throughout the same period. After March, a reduction in numbers occurred which was maintained in April and May. By June it had almost completely disappeared.

Chætoceros: It also occurred in September and most species had increased considerably by October. In November some of the species were seen in lesser numbers, but a second maximum occurred either in January or February for these. The commonest forms were *Ch. peruvianus* Brightwell (max. third week of December), *Ch. Lorentzianus* Grunow (first max. end of October, second max. early February), *Ch. diversus* Cleve (first max. middle October, second max. early January), *Ch. affinis* Lauder (max. early February), and *Ch. didymus* Ehr. (max. end of January). From May to August it was rare.

Rhizosolenia: It was seen from September to May. Its maximum occurred towards the end of December and was maintained till the end of February. The common species were *R. imbricata* Brightwell, *R. setigera* Brightwell and *R. hebatata* Gran., all reaching their maxima between January and February.

Biddulphia: Of this genus, the commonest species was *B. sinensis* Graville. It occurred towards the end of August and was common in September, when the other species of this genus were poorly represented. It reached its maximum in January, but was seen right till April in lesser numbers. *B. mobiliensis* Bailey had its maximum at the end of December. The other species of *Biddulphia* occurred occasionally in varying numbers.

Pleurosigma: It was common from November to May, reaching its maximum towards the end of April. The commonest species was *P. normanii* Ralfs.

Of the other Diatoms, *Bacteriastrum hyalinum* Lauder, *Planktoniella sol* (Wallich) Schütt and *Nitzschia seriata* Cleve were never absent from any collection except during the rains. *Melosira* though rare throughout the year, was seen in appreciable numbers in April.

Among the Peridinians, the common genera were *Dinophysis* (3 species), *Ceratium* (9 species) and *Peridinium* (10 species). All appeared from November till March. The commonest species of *Dinophysis* was *D. miles* Cleve (max. early Dec.). *Ceratium* was best represented by *C. fusus* Ehr. and *C. furca* Ehr. Both had their maxima towards the end of December. The commonest species of *Peridinium* were *P. depressum* Bailey (max. early December) and *P. oceanum* Vanh. (max. end of December). *Ornithocercus* occurred in December, but not in large amount.

A general comparison only can be made here with the observation of workers in other parts of India. In Bombay the period of phytoplankton scarcity is from May till August after which there is an increase till the maximum is reached in January and February. In Madras,[4] the maximum is in April and May followed by a fall in numbers. After a small rise in July, there is almost complete absence of the Diatoms from the plankton till the middle of September, when there begins a gradual increase. In Trivandrum,[3] the Diatom maximum occurs in April and May as in Madras. This maximum as it coincides with the onset of the south-west monsoon is attributed to the river floods bringing in large quantities of organic and inorganic food materials into the sea. In Bombay, as there are no rivers, there is no phenomenal increase in the Diatom population in May. In fact, there is almost total absence of form. This can be attributed to the disturbed and unsettled condition of the water brought about by the thunderstorms and fairly heavy rains that accompany the south-west monsoon, or it may be due to the exhaustion of the essential plant foods.

This investigation was carried out at the Royal Institute of Science, Bombay. My thanks are due to Dr. D. V. Bal for placing the material at my disposal and for his valuable suggestions, as also to Mr. L. V. Pradhan for arranging to obtain the samples.

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HEARTBEATS

JOHN ERIC HILL

THE heart of a warm-blooded vertebrate is an extraordinary, hard-working pump, functioning at a level of activity unequalled by any mechanical device. The wonder is that any heart beats as long as it does. The average person's heart beats about 72 times a minute, 4,300 times an hour, and more than 2,500,000,000 times in a life-time of 70 years. While you are reading this, each minute the heart pumps about 10 quarts of blood, doing work at a rate of about 200 foot-pounds per minute. If you are in good physical condition and run quickly up a flight of stairs, your heart may work three times as hard.

The pulse rate varies greatly in different mammals. When a mouse is resting, its pulse is about 700, ten times as fast as man's. A cat's heart beats about 120 per minute, a dog's 85 to 125, while a horse's or cow's heart beats only 35 to 45 times a minute. The heart beats more rapidly in a young mammal than in an older one. Even in adults of the same species a small individual has a faster heart-beat than a large individual. A toy terrier, for instance, may have a pulse more than half again as fast as a St. Bernard's. From this, the conclusion may be drawn that the heart rate in mammals generally decreases with an increase in size.

This is because a small mammal lives at a high speed. A mouse's metabolic rate, measured by its consumption of oxygen per unit of weight is about 20 times that of a man. A small dog may need, for its size, twice as much food as a large dog. The rapid loss of heat by radiation from a small body requires the "fires" of life to blaze high continually.

Some of the extra circulation necessitated by these factors may be provided, in part, by relatively large hearts. The normal human heart is about one two-hundredth of the weight of the body. The heart of a small bat may be relatively three times as large. Mammals that lead a very active life, as diggers or swift runners, may have disproportionately large hearts. That of a deer, a badger, a wolf, or a weasel may be one-hundredth of its weight. In contrast, hearts of sedentary domestic animals or secretive rodents are only about one-half or one-third as large. A jack rabbit's heart is almost three times as big as that of a domestic rabbit weighing the same amount; and when it is resting, it pumps about the same amount of blood but at a rate only one-third as fast. When the jack rabbit must run for its life, its heart can speed up and pump four times as much as while resting.

There is a relation between the speed of the heart-beat and the life-span of an animal. The mouse with a pulse rate of 700, lives only about two years; its heart performs a total of some 700,000,000 beats. A cat or dog lives through about the same number of heart-beats, and an elephant may live through 1,000,000,000. Some of our smaller bats, with the fastest heart-beat of any mammal, live eight years or more. If they hibernate, as they do in the cold north, the heart-beat drops from 700 or more to only 30 a minute. Allowing for this decrease in activity, such bats have a heart-life of some 2,000,000,000 beats.

—Courtesy, "Natural History".

NEW STATISTICAL METHOD OF PREDICTING SUNSPOTS

THE prediction of solar activity, which greatly affects radio communication and is evidenced by spots on the sun, has been advanced through the application of a new statistical method, by A. G. McNish and Virginia Lincoln of the National Bureau of Standards, Washington. The new technique, depending on available sunspot data for a number of previous 11-year cycles, has a sounder scientific basis than former methods of prediction. Moreover, it is expected to be applicable to a wide variety of cyclical phenomena, such as long-term weather variations and climatic changes (*cf.* Ramamurthi, *Curr. Sci.*, 1947, p. 213).

Long-distance radio transmission is made possible by the ionosphere, a series of layers in the atmosphere 50 to 250 miles above the earth. Radio waves sent out near the earth's surface travel in straight lines until they reach the ionosphere and are reflected back to the earth, just as light striking a mirror is reflected. This reflection of radio waves is due to the fact that the ionosphere is made electrically conducting as a result of the ionization of gas molecules in its layers by ultraviolet light from the sun.

With the discovery of the close relationships existing between radio propagation and sunspot activity, the prediction of sunspot numbers assumed great practical importance. In the development of a satisfactory sunspot-prediction formula at the National Bureau of Standards, it was assumed that (1) in a time series exhibiting cyclical tendencies, a first approximation to a future value is the mean of all past values for the same stage of the cycle, and (2) this approximation can be improved by adding to the mean a correction proportional to the departure of earlier values of the same cycle from their respective means. The second assumption is justified by the observed tendency in sunspot numbers for annual deviations from the mean to have the same sign and similar magnitudes in consecutive years.

The prediction formula then becomes

$$R_n' = \bar{R}_n + k_{n-1} \triangle R_{n-1} + k_{n-2} \triangle R_{n-2} \cdots$$

where R_n' is the predicted value in a particular cycle, R_n the mean of all corresponding values in preceding cycles, $\triangle R_{n-1}$ the deviation of the particular R_{n-1} for this cycle from the mean of all R_{n-1}'s from previous cycles, and the k's are proportionality constants.

The least-squares criterion that the sum of the squared deviations from the mean be a minimum was used in evaluating the proportionality constants. Upon comparison of observed values with those predicted by this method, it was apparent that the best prediction is usually obtained by setting all of the k's except in one for the previous year equal to zero, and this procedure is followed in most cases.

The sunspot number is obtained by counting the number of sunspot groups, multiplying by ten, and adding to the result the number of individual sunspots in each group. This statistical convention was adopted at the Zürich Observatory in the middle of the nineteenth century, and since that time has been standard all over the world. The highest monthly average sunspot number in over 100 years, and one of the highest of all time, occurred during May 1947.

The importance of sunspot prediction is shown by comparison of radio transmission in 1944 with that in 1947. In 1944 sunspots were at a minimum, the ionosphere was weakly ionized, and the higher frequency radio waves passed out into space without reflection. During the year, transmission across the North Atlantic was rarely possible for frequencies above 20 megacycles. For 1947, on the other hand, the extremely high annual sunspot number of 126 is predicted, and already transmissions using frequencies above 50 megacycles have been logged over this path.

Daily "soundings" of the ionosphere are taken all over the world by an international network of 58 ionosphere stations, 14 of which are operated or supported by the Bureau. These daily soundings measure the critical frequency (the limiting frequency for reflections back to the earth), absorption of radio energy (an indication of the power required to transmit a given frequency over a particular distance), and the heights of the various layers (determined through the use of radar-like echo equipment). The sunspot predictions are correlated with this information to provide the working data used at the Bureau in predicting radio propagation characteristics.

Groups now using the service include airline companies, steamship lines and the merchant marine, television and radio schools, American and foreign universities, radio and telegraph companies, manufacturers of communication equipment, research laboratories and geophysical exploration organizations.

ATOMIC PILE PRODUCTS TO REPLACE SURGERY

MEDICAL physicists, in dozens of the United States laboratories, are working to-day on what promises to develop into the first evolution of therapy and surgery through atomic fission. The process that fascinates the pioneers of nuclear medicine is the so-called "selective localisation" of radioactive elements in the human body. Its perfection, in simple terms, would amount to the destruction of diseased body tissue, not by the surgeon's knife, but by the radioactivity of chemicals taken internally. The key to the evolution lies in the radioisotopes, those radioactive twins of normal elements which are produced in the atom-smashing cyclotron or in the atomic pile.

At the University of California in Berkeley, one of the foremost centres of medical physics in the United States, Dr. John L. Lawrence has been working with radioactive isotopes for more than twelve years.

In his laboratory on the Berkeley campus he described the present status of medical physics and what is emerging as the next step in therapy.

Dr. Lawrence explained, "Here at Berkeley we have produced isotopes in the atom-smashing cyclotron since 1934. The atomic pile, less versatile than the cyclotron, has but one great advantage—mass production of isotopes. That means that such isotopes as carbon 14 are now widely available. It means that cyclotrons can now concentrate on producing those valuable isotopes which are too short-lived to be shipped; they would decay during shipment. We now get carbon 14 delivered; that means that in our cyclotron we can produce more carbon 11, another isotope so short-lived that it loses half its radioactivity within 21 minutes. Yet, by rapid expereimental work, we were able to use it, and have come to astonishing results.

"With the methods now available, that is to say mainly cyclotron and pile, radioactive forms of nearly all the 92 or more elements in the periodic table can be produced artificially. With carbon 14 alone, a dozen new laboratories could be kept busy for the next thirty years, so vast is the scope of its peace-time application.

Beginning of New Era in Medical Knowledge

"We have seen only the beginning of a new era in man's medical knowledge. In the Berkeley laboratories we have used for biological and medical research some 40 isotopes so far, among them carbon 11 (with a half-life of 21 minutes); hydrogen (with a half-life of 31 years); two isotopes of sodium, and one each of phosphorus, sulfur, calcium, iron and iodine. Considering that in the human body there are only some 20 elements of major importance, the scope of research and therapy that might evolve from some 100 radioactive substances become apparently limitless. And medicine may look forward to a revision of accepted theories, to new knowledge, and to new riddles..

Therapeutic Application of Radioactive Isotopes

"In our latest tracer experiment we found that certain redioactive isotopes along with their inactive sister-elements show a definite tendency to deposit themselves in certain areas of the body. It is this tendency which we call 'selective localization' and which promises to develop into a broad new field of therapeutic application of radioactive isotopes. For example, radioactive carbon-monoxide, compounded with the short-lived isotope carbon 11, was gobbled up by the liver and held there for a while, before being released. We know that radioactive iodine 131 tends to settle in the thyroid gland. The concentration of iodine atoms in the gland may be several hundred times that in any other part of the body. Wtih larger than tracer doses it was possible in rabbits to remove their thyroid glands by slow selective radiation which destroyed the glands without damage to other tissue. Other isotopes concentrate in the bone marrow, still others in the spleen.

"What we are now trying to do, after these initial observations and the successful treatment of goiter by internal radiation, is this: we try to find compounds which would localize in a specific area of the body. If we find such a compound for each vital organ, we can introduce it in the body and hit the abnormal area without damage to other organs.

"Many diseases, particularly in the cancerous group, require radical removal of the diseased tissue. Selective radioactive compounds would settle down in the affected areas, bombard the diseased tissue with radiation and destroy it, making the surgeon's work unnecessary. Ultimately, we might find a radioactive compound for each particular organ and for each particular type of cancer.

"To-day we are at the beginning of fundamental research. A stream of contributions can be expected from the mass production of radioactive isotopes which are the stepping stones to the medical methods of tomorrow."—*USIS.*

GEOMAGNETIC STORMS

Some details of the geomagnetic storms recorded at the Alibag Magnetic Observatory during the quarter July to September 1947 are given in the following table in which t_0, t represent the time (I.S.T.) of commencement of the disturbance and its intense phase respectively and T the duration of the intense phase expressed in hours. The ranges in the three different elements (D, H and V) of the earth's magnetic field have also been given, D, in minutes of arc, H and V in γ where $1\gamma = 10^{-5}$ gauss. The maximum k-index recorded during the storms have also been given.

Date	t_0	t	T	Range			k_m	Nature of commencement
				D	H	V		
1947	H. M.	H. M.	Hrs.	Min.	γ	γ		
July, 17–19 ..	23 18	18 14	6	8·5	298	62	8	Sudden
August, 15–17 ..	15 20	21 36	8½	10·6	264	72	7	Sudden
August 22-24 ..	14 40	14 43	4	9·0	306	87	8	Sudden
September, 3–4 ..	04 54	11 00	5	14·7	373	135	8	Sudden

LETTERS TO THE EDITOR

OSCILLATION CHARACTERISTICS OF A HARTLEY OSCILLATOR

Appleton[1] and Appleton, Watt and Herd[2] determined the oscillation characteristics by direct experiment for valve circuit. They did not try the Hartley circuits. Neither did they draw the oscillation characteristics by calculation from the static characteristic curves of the valve. In the present communication comparative study of the oscillation characteristics for the Hartley oscillator by the two methods is put forth.

2. Let M be the mutual inductance between the grid and the plate coils whose inductances are L and L_a having negligible resistances. The relation between the induced anode potential v_a and the induced grid potential v_g is given by

$$v_a = -\frac{L_a}{M} v_g \qquad (1)$$

It is well known that M must be negative to produce self-excitation so that v_a and v_g are in opposite phase. The anode current I_a at any instant is a function of both the anode and grid potentials for a given filament current; and the action of a triode is usually interpreted in terms of the relation,

$$I_a = \phi\,(V_0 + v_a, v_g) \qquad (2)$$

where V_0 is the steady potential applied to the plate of the valve. The direct determination of the relation betyeen I_a and v_a can be done when the values of v_g are made consistent with the relation (1). Then we have

$$I_a = \phi\left(\overline{V_0 + v_a}, -\frac{M}{L_a} v_a\right) \qquad (3)$$

as oscillation characteristic.

3. A parallel fed Hartley Oscillator circuit suitable for short-wave range 50 to 150 metres, of which the oscillation characteristics were determined is shown in Fig. 1. This is fitted

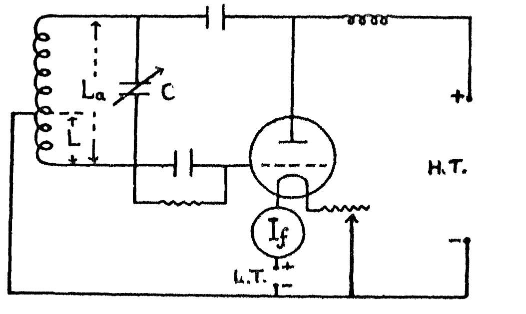

Fig. 1

with the usual pulse generating device of a fixed condenser shunted by a high resistance.

From the dimensions of the coil L_a and the position of tapping, the values of L_a and M were calculated by usual formulæ and found to be 18·6 and 10·1 μH respectively, giving the ratio

$$\frac{L_a}{M} = 1 \cdot 84. \qquad (4)$$

As a check the value of L_a was experimentally determined by calibrating the oscillatory circuit for wave-length λ and plotting a graph between λ^2 and the corresponding capacity of the variable condenser C. This graph is evidently a straight line. The gradient of this line gave

TABLE I
(V_0 = 60 volts)

v_a volts ..	+10	+8	0	−10	−14	−20	−30	−35	−40	−50	−60
I_a mA ..	..	1	5	13	16	20	25	26	24	14	0

TABLE II
V_0 = 100 volts

v_a. Volts. ..	+20	+16	+10	0	−10	−20	−30	−40	−50	−60	−70	−80	−90	−100
I_a mA ..	..	1	3·5	12	22	30	36	39	40	37	32	22	13	0

the value of L_a as 18·58 μH, which is in close agreement with the calculated one.

The experimental arrangement for the direct determination of oscillation characteristics is shown in Fig. 2. The fixed non-inductive

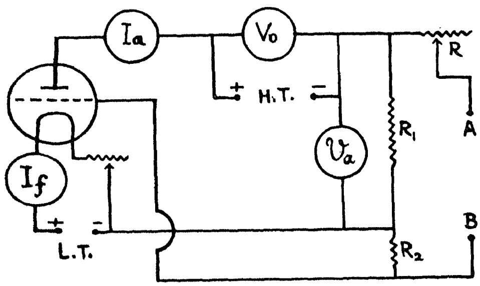

FIG. 2

resistances R_1 and R_2 are so chosen that

$$\frac{R_1}{R_2} = \frac{L_a}{M} = 1\cdot 84$$

A variable resistance R serves to adjust the potential v_a to any required value, which can also be made negative or positive by interchanging the connections of D.C. supply between A and B. The filament current was maintained constant at the rated value of 150 mA. A series of readings of I_a corresponding to v_a beginning from positive and ending with negative values were recorded, for

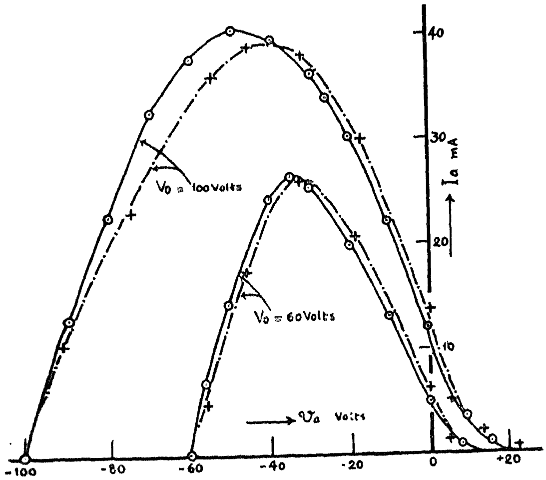

FIG. 3

two different values of V_0. These are given in the Tables I and II.

The two oscillation characteristics are graphically shown in Fig. 3 by full lines.

4. Appleton[1] has mentioned that the oscillation characteristics of a circuit could be drawn from the I_a, v_g curves of the valve but this process involves laborious calculations. The present author has used plate-potential plate-current characteristic curves for different grid bias, to effect simplification.

With this in view, V_a, I_a static curves were determined for several values of V_g ranging between − 12 volts to + 60 volts. Then using relations (1) and (4) and remembering that $V_a = V_0 + v_a$ the values of I_a are read off from these curves corresponding to the values of V_a. Calculations are made for two oscillation characteristics corresponding to V_0 equal to 60 and 100 volts. These are given in Table III.

TABLE III

v_g Volts	v_a Volts	V_0 = 60 Volts		V_0 = 100 Volts	
		V_a Volts	I_a mA	V_a Volts	I_a mA
−12	22·1	82·1	..	122·1	0·5
− 8	14·7	74·7	0·5	114·7	1·5
− 3	5·5	65·5	1·0	105·5	5·0
0	0	60·0	6·0	100·0	13·5
10	−18·4	41·6	20·5	81·6	29·5
18	−33·1	26·9	25·5	66·9	37·5
25	−46·0	14·0	17·0	54·0	38·5
30	−55·2	4·8	4·5	44·8	35·5
40	−73·6	..	..	26·4	22·5
50	−92·0	..	..	8·0	10·0

The two calculated oscillation characteristics are shown by broken lines in Fig. 3.

5. Although there is a slight difference between the calculated and the observed values of I_a yet the agreement between the two may be deemed as fairly good considering the uncertain factors like over-heating of the valve in such experiments.

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July 17, 1947.

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TIME FACTOR IN ELECTRIC BIREFRINGENCE OF GLASS

THAT electric birefringence has a time-lag behind the instant of the application of the electric field has been well known ever since the discovery of the effect by Kerr in 1875. This time-lag has also been known to be of much greater magnitude in solids than in liquids and gases. Kerr himself estimated the lag for glass as about half a minute, within which, he observed, the substance exhibits full and maximum birefringence. While this has been found to be substantially true—at least approximately—in the densest flint glass containing the highest percentage of lead, recent experiments undertaken to determine the Kerr coefficient in a variety of glass samples have, however, revealed interesting departure from Kerr's conclusions on the point. It has been observed in all varieties of glass, except the densest flint referred to above, that although the electric birefringence and, therefore, the Kerr coefficient increases at first to a positive maximum within about a minute of the application of the field, in the intervals of the time to follow, they do not remain constant at that peak value in a steadily applied field of force. For several minutes to follow, these varieties have all exhibited a decreasing birefringence settling down to a minimum of residual positive value in cases of lead glasses, and to a minimum of reversed negative value in samples free from lead; the time required for this downward creep depending on the composition of sample under observation. The amplitude of the downward creep and of the reversal, as the case may be, has been found to be magnified by an increase in the applied field, while the time-lag of the effects in general is observed to decrease.

The effect observed on the withdrawal of the field, having almost the nature of an optical image of that observed on the application, is also highly interesting. Contrary to Kerr's observation that the electric birefringence decreases steadily to zero value within about half a minute of the withdrawal of the field (which has, of course, been confirmed with the densest flint glass containing the highest percentage of lead), it has been observed in all other varieties that the birefringence diminishes down to a reversed negative value within about a minute of the withdrawal of the field, and then tends slowly to creep up to zero value in several minutes to follow, the time required by the sample to revert to its normal condition of non-birefringence, being usually long, and also depending on the composition of the variety under examination.

The nature of the variation observed seems to suggest that the total effect observed is due to the superimposition of two component effects of opposite signs, one of which, the positive one, is to be taken as the Karr effect as regards the negative components, it might, at the first thought, be taken as the electrostriction effect. But the effect arising out of the electrostriction may be estimated in any sample either by the experiment or from theoretical considerations. This must be very small in comparison with electro-optical effect, for, in glass, while the coefficient of the electro-optical effect is of the order of 10^{-9}, that for the strain-optical effect has the order of 10^{-13}.

The negative effect in some cases, has, however, been observed to be of magnitude comparable with the positive. Further, strain-optical effect arising out of electrostriction should increase with the dielectric constant of the sample. But observations show that samples having a comparatively higher dielectric constant are characterised by a feeble negative effect. These considerations exclude the possibility of the negative effect being identified with electrostriction.

The details of the experiment undertaken along with the curves showing the variation of the Kerr constant with time will be shortly published in a paper elsewhere.

I acknowledge my indebtedness to the Indian Association for the Cultivation of Science, Calcutta, and to Prof. K. Banerjee for the facilities of experimental work and valuable suggestions given to me.

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THE CHROMITE AND ASSOCIATED ROCKS OF KONDAPALLE (Kistna District)

THE chromite deposits and associated rocks of Kondapalle, situated in an area (16° 37': 80° 32½'), about ten miles to the N.W. of Bezwada, have been studied. The geological features of the area comprise, the Bezwada gneisses, the granitic gneisses and the charnockites, and the chromite deposits are restricted to the ultra-basic charnockites, mainly the pyroxenites (enstatite-hypersthene rock). The occurrence of the chromite is chiefly in the form of pockets or lenses, in disseminated patches and often in regular and perfect bands. No olivine has been found, and the serpentine noticed in certain places is due to the alteration of pyroxene. Chemical analyses of representative chromite ores from the area show that the value of Cr_2O_3 of the ore ranges from 36 to 55 per cent. The detailed field and petrographic study indicates that the chromite of Kondapalle is magmatic in origin, the ore crystallising as the first mineral and later joining with the orthopyroxene.

The charnockites, which are the main associated rocks of the chromite deposits of Kondapalle, occur as bouldery outcrops often times steep and precipitous. They reveal the development of all the four, the acid (sp. gr. 2·80), the intermediate (sp. gr. 2·91), the basic (sp. gr. 3·01) and the ultrabasic (sp. gr. 3·25) types. They are, however, best developed at Ibrahimpatnam, three miles due south of Kondapalle. The detailed field and petrographic study of these show in general, a close similarity to the charnockites from the Type area; but a slight difference in mineral composition is noticed, particularly among the norites. Garnetiferous norites, so clearly seen in the Type area, are not well developed at Kondapalle, thereby showing that the charnoc-

Constituents	Acid charnockite			Basic charnockite			Ultrabasic charnockite		
	K. Palle	Type area	Mysore	K. Palle	Type area	Mysore	K. Palle	Type area	Mysore
SiO_2 ..	66·97	77·47	78·57	49·09	50·04	50·11	45·34	46·86	48·24
Al_2O_3 ..	13·26	11·00	11·97	9·68	11·65	14·31	2·03	9·80	13·03
Fe_2O_3 ..	3·61	1·04	0·84	10·48	2·63	2·00	11·09	16·35	2·28
FeO ..	4·90	2·02	1·16	11·42	15·76	11·38	19·28		7·20
TiO_2 ..	Trace	0·26	0·24	0·01	1·93	0·84	Trace	..	Trace
CaO ..	4·51	1·02	3·06	10·92	7·89	11·52	5·64	9·57	13·48
MgO ..	1·80	0·43	0·27	3·95	5·58	7·64	12·65	18·08	10·72
MnO ..	0·08	..	0·20	0·20	..	0·31	0·56	..	0·81
Na_2O ..	1·09	2·86	3·90	3·00	3·08	2·37	0·51	..	2·88
K_2O ..	3·92	4·14	0·52	0·90	0·89	0·16	Trace	..	0·23
S. ..	..	..	..	0·11	..	..	2·57	..	0·15
BaO ..	..	..	..	..	..	..	Trace	..	..
ZrO ..	Trace	..	..	..	..	..	..	..	..
P_2O_5 ..	..	..	0·05	..	0·20	Trace	Trace	..	0·07
H_2O ..	0·26	0·25	0·30	0·47	0·19	0·37	0·24	0·67	0·64
Cr_2O_3 ..	0·01	..	..	Trace	..	..	0·11	..	..
Total ..	100·41	100·49	101·08	100·20	99·69	101·01	99·96	101·33	99·73

Norms of the above

	Acid K. Palle	Acid Type area	Acid Mysore	Basic K. Palle	Basic Type area	Basic Mysore	Ultrabasic K. Palle
Quartz ..	26·76	41·22	44·48	3·05	..	..	7·20
Orthoclase ..	22·80	24·46	2·78	5·56	5·00	1·11	..
Albite ..	16·24	24·10	33·01	25·15	26·20	20·04	4·19
Anorthite ..	16·12	5·00	13·90	10·29	15·27	27·52	3·34
Diopside ..	5·10	..	0·92	36·66	19·43	24·49	20·42
Hypersthene ..	7·89	3·34	1·82	3·28	20·27	15·89	42·38
Olivine ..	..	..	..	..	5·63	6·00	..
Ilmenite ..	..	0·61	0·46	0·15	3·65	1·52	..
Magnetite ..	5·34	1·02	1·16	15·08	3·71	3·02	16·01
Apatite ..	..	..	0·34	..	0·34	..	..
Pyrites ..	..	..	..	0·36	..	..	3·66

kites of Kondapalle are not uniformly subjected to such an advanced stage of metamorphism when garnet can make its appearance. Mineral transformations due to metamorphism, like the amphibolisation of pyroxene and the conversion of hypersthene to garnet with the formation of kelyphitic borders are clearly seen. Chemical analyses of the representative charnockites from Kondapalle, in comparison with those from the Type area and Mysore are given in the above table.

The field relationship of the charnockites of Kondapalle, their texture, mineral constituents and chemical composition, all point towards an igneous origin of this suit of rocks, later subjected to plutonic metamorphism.

Details of these studies will be published elsewhere.

The author wishes to express his deep sense of gratitude to Mr. B. V. Iyengar, M.Sc., and Mr. M. R. Sreenivasa Rao, M.Sc., for their valuable suggestions and to Sir J. C. Ghosh, Kt., D.Sc., F.N.I., for his keen interest in the subject.

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EFFECT OF BIOTIN ON NITROGEN CONTENT OF YEAST

The "biotin effect", or the rise in the respiratory and growth-rate of biotin-free yeast (*S. cerivisece*) on the addition of biotin in the presence of assimilable nitrogen, has been noted by Winzler and co-workers.[1] But an adverse effect on the nitrogen content of yeast was observed by Hartelius[2] on the addition of biotin in the presence of β-alanine or pantothenic acid, while thiamin or glutamic acid raised the nitrogen content.

The present note is a report of the effect of biotin on the nitrogen content of *S. cerivisece*

Table I
Effect of biotin on the nitrogen content of yeast

Period of incubation in hours	Total N_2 in mg./ml.	
	With Biotin	Without Biotin
0	0·7467	0·7467
12	0·7830	0·6681
24	0·7348	0·6116
36	0·7104	0·6148
48	0·7298	0·5961
60	0·7138	0·5818
72	0·6951	0·5890

TABLE II
Effect of biotin on nitrogen content and growth-rate of yeast

Period of incubation in hours	With Biotin		Without Biotin	
	Total N_2 mg/ml	Growth*	Total N_2 Mg/ml	Growth*
0	0·7050	14·0	0·7050	14·0
6	0·8136	25·5	0·7360	23·5
12	0·7597	32·5	0·6298	27·0
18	0·7433	32·5	0·6272	29·5
24	0·7392	32·5	0·6194	29·5

* Expressed as deflection of galvanometer.

observed on comparing the growth on an all-vitamin medium with that on a biotin-free medium. The former[3] was made up of glucose, saline buffer, ammonium sulphate, *l*-aspartic acid and 1·5 μg. each of thiamin, pyridoxine, riboflavin, calcium pantothenate and nicotinic acid, 7 $m\mu$g. of biotin and 55 μg. of inositol in 5 ml. total volume of medium and inoculum. The yeast from a 24-hour slant was grown in 50 ml. conical flasks, each flask containing 4·5 ml. medium and 0·5 ml. inoculum for 36 hours at 28° C.

The yeast was then centrifuged, washed five times with 0·9 per cent. saline under sterile conditions, and suspended in saline, adjusting it to the required turbidity for the inoculum. The turbidity was photoelectrically measured with 0·5 ml. of the inoculum diluted to 10 ml. It was then inoculated into the all-vitamin medium (A) and into biotin-free medium (B). The total nitrogen content of the inoculum, and of yeast grown on A and B at intervals, was determined with 1 ml. of the suspension by the microkjeldahl method.

The growth of the yeast was measured photo-electrically at stated intervals after diluting the contents to 10 ml.

Tables I and II show the effect of biotin on the growth and assimilation of nitrogen by yeast cells. During the first six hours there is 15 per cent. increase in the nitrogen content of yeasts grown on an all-vitamin medium with subsequent fall in the values. Yeast grown on a biotin-free medium shows a slight increase in nitrogen in the first six hours, but there is a sharp decline after this period. In no case, however, does the nitrogen content of yeast on a biotin-free medium approach that of yeast on an all-vitamin medium. The slight increase of nitrogen in the biotin-deficient yeast during the first six hours may be due to traces of biotin initially present in the yeast cells.

It was of interest to study the response of yeast cells grown on biotin-deficient medium and to additions of optimal and suboptimal doses of biotin. Table III gives the effect of addition of 5 $m\mu$g. and 0·8 $m\mu$g. of biotin to yeast grown for 12 hours on a biotin-free medium.

There is a marked increase within 6 hours in the nitrogen content of yeast when an optimum quantity (5 $m\mu$g.) of biotin is added. Even a sub-optimal dose (0·8 $m\mu$g.) increases the nitrogen content. These results lend further support to the fact that biotin influences the uptake of nitrogen by yeast.

TABLE III

Without Biotin						With Biotin			
0 Hours		12 Hours		18 Hours		18 Hours 5 $m\mu g$ Biotin		18 Hours 0·8 $m\mu g$ Biotin	
Total N_2 mg/ml	Growth*	Total N_2 mg/ml	Growth*	Total N_2 mg/ml	Growth*	Total N_2 mg/ml	Growth*	Total N_2 mg/ml	Growth*
0·8283	13·5	0·5913	27·5	0·5926	30·0	0·7718	31·0	0·6693	30·5

* Expressed as deflection of galvanometer.

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THE POSSIBLE SIGNIFICANCE OF THE NUCLEIC ACID METABOLISM IN RELATION TO PENICILLIN BACTERIOSTASIS

MUCH of the nitrogen and phosphorus in the living cell exists in the form of nucleoproteins, constituting the chromatin which acts as the carrier of genes. These nucleotides and their derivatives are distributed among the vital elements of the cells both in the nucleus and

in the cytoplasm and play important roles in cell reproduction,[1-2] thus forming the most characteristic and active constituents of living matter.

In a series of experiments carried out to elucidate the mechanism of action of penicillin, working with gram positive organisms like *Staph. aureus, Strept. viridans* and *B. subtilis*, we have shown that nucleic acids (pure samples of nucleic acids obtained from B.D.H. was used) possess the property of antagonising penicillin action.[3] Organisms which are rendered non-viable by prolonged contact with penicillin are revived in the presence of added nucleic acids, so that they are enabled to grow and multiply in the normal manner. We also observed that nucleic acids can restore original morphological characteristics to cells which undergo changes in shape and gram-staining reaction due to penicillin contact.[4] Indeed the work of Avery *et al.*,[5] McCarty,[6] establishing that the active substance responsible for transformations in pneumococcal types is a specific nucleic aci dof the desoxy ribose type, is very interesting and significant in this connection. On the basis of these and other observations we have suggested that penicillin interferes with certain phases in the metabolism of the organisms where nucleic acids feature either as metabolites helping cell-division or function as respiratory catalysts or as both.

Metabolic rate is at its maximum during the growth phase of the bacteria, and the observations of many workers[7-10] support the conclusion that young rapidly growing organisms are the ones which are most susceptible to the action of penicillin and that substances in the media which enhance the growth of the bacteria seem to render them more sensitive to its action. Again, it has been observed that if the bacteria are inoculated into a medium which is lacking in some of the growth requirements, the efficiency of the penicillin is definitely lowered. Further, the fact that penicillin apparently does not affect the bacteria in the resting stage as shown by its failure to produce morphologic or cultural changes in very old cultures or when maintained at low temperatures proves that this is not merely a physical or chemical effect on the body of the bacterial cell but one that influences some phase of the organisms, metabolic and reproductive activity.[11] These remarks point to a very striking correlation existing between the cellular components such as the nucleic acids, active in cell reproductivity processes and the inhibitory action of penicillin on them.[3-4]

These observations raise the important issue of the condition of the host and the presence or otherwise of nucleic acids and related products in blood and tissue fluids during the progress of the disease. The response of the host to penicillin treatment would naturally be determined by such factors. Further studies bearing on these aspects are in progress.

Our thanks are due to Prof. V. Subrahmanyan and Major K. P. Menon for their kind interest in the work and helpful discussions and also to the Council of Scientific and Industrial Research under whose auspices this work is being undertaken.

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BIOLOGICAL VALUE OF "SOYA-BEAN MILK" PROTEINS BY REGENERATION OF LIVER PROTEIN IN THE RAT

THE rate of regeneration of liver protein in the rat following a period of fast is an index of the nutritive value of the protein fed.[1-4] Recent work[3,4] has amplified this simple and rapid method of assay of the biological values of proteins and defined the experimental conditions for obtaining accurate results. It has been shown that the labile protein of the liver represents true liver cytoplasm.[2] The sulphur-containing amino-acids play an important part in liver protein synthesis.[3]

The biological value of soya-bean milk proteins as compared with casein has been assessed by this method, the experimental technique being essentially the same as that adopted by Harrison and Long.[3]

Adult albino rats of both sexes weighing 150-200 gms. were fed for about a week with a stock synthetic diet of casein, wheat flour, coconut oil, minerals and vitamins. The animals were then divided into groups comparable in regard to number, sex, and body-weight distribution. They were fasted 48 hours and fed the experimental diets, one containing casein and the other the proteins of "soya-milk", at a level of 10 per cent. A protein level of 10 per cent. was chosen for comparison in order to obtain marked effects of any deficiencies in the test protein during the rather short experimental period.

The proteins of soya-milk[5] were precipitated at pH 4·2, and subsequently dried at 40° C. The experimental diets were isocaloric and contained in addition to protein, corn starch 66 per cent., cane-sugar 10 per cent., cocoanut oil 10 per cent. and Wesson's salt mixture[8] 4 per cent. Adexolin and Squibb's yeast tablets supplemented with adequate amounts of thiamine and riboflavin provided the vitamin requirements. The protein in the yeast tablets constituted only 0·69 per cent. of the diet and was common to both. A 12 gm. ration of the

Group	Number of Rats	Protein fed during the period gms.	Liver protein nitrogen mgm/100 gm. of b.w.	Liver fat Gm/100 gm. of b.w.	Liver protein nitrogen increment over fasting level
Controls ..	12	..	110 ± 2·0*	0·174 ± 0·01*	..
Fasted 48 hrs. ..	6	0·0	83 ± 2·4	0·169 ± 0·01	..
Refed 10% casein diet					
2 days ..	6	2·2	108 ± 2·5	0·205 ± 0·02	25
4 days ..	6	4·2	110 ± 3·0	0·185 ± 0·018	27
Refed 10% soyabean protein diet					
2 days ..	6	2·2	105 ± 2·2	0·201 ± 0·02	22
4 days ..	6	4·2	105 ± 2·0	0·197 ± 0·015	22

* Mean ± standard error of the mean

diet was fed to each rat on the first day, and 10 gms. on the succeeding days of re-feeding. The average caloric intake of the animals during the re-feeding period was 24-26 cals./100 gms. body-weight, and fulfilled in this respect the important condition laid down by Kosterlitz and Campbell.[4]

At the ends of the appropriate experimental periods, the groups of rats were anæsthetized with amytal and exsanguinated through the abdominal aorta in order to ensure minimum and approximately uniform amount of residual blood in the livers. The whole liver was then excised from each animal and dried to constant weight at 95° C. The dried liver was ground to a fine powder and aliquots taken for total nitrogen and total lipid estimations.[3] The true protein nitrogen value of the liver was calculated as the difference between the total nitrogen and the non-protein nitrogen which was determined by analysing separately a 5 per cent. trichloracetic acid extract from an aliquot of the liver powder.

The results obtained have been tabulated below. All values are expressed in terms of body-weight (b.w.), the reference weight used for calculation for both the fasted and the re-fed animals being the body-weight immediately prior to the fast.

The above results show clearly that on the basis of the liver protein nitrogen increments over the fasting level in the two groups, the biological value of the soya-bean milk proteins works out to 81·5 per cent. that of casein. This value is slightly lower than those obtained by other methods[6] presumably because the soya-bean proteins are relatively low in methionine content[7] which is one of the important limiting factors in respect of liver protein regeneration.[3]

We wish to thank Prof. V. Subrahmanyan for his kind interest in the above work.

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PROLONGATION OF INSULIN EFFECT BY COMBINING IT WITH CASEIN-HYDROLYSATE

Two well-known preparations (1) Protamine-Zn-Insulin[1] and (2) Globin-Insulin with Zn are now widely used in the treatment of Diabetes Mellitus. The prolonged hypoglycæmic action of the first compound has been attributed to its comparatively low solubility at the pH of blood and tissue fluid and the consequent slow rate of absorption of Insulin in the body. Reiner *et al.*[2] after studying various Insulin preparations came to the conclusion that the rate of absorption of Insulin was determined not only by the insolubility of the preparation employed but by other factors as well. These authors described a preparation, Globin-Insulin which is believed to be a loose combination of Globin and Insulin. The onset of hypoglycæmia with this preparation is rapid when compared with protamine-Zn-Insulin, but its disappearance slow when compared with ordinary Insulin.

Both these preparations are combinations of Insulin with other proteins. It appears to us that Insulin has also the property of combining with 'simple peptides'. When this combination is injected into the body, the Insulin is released gradually and the nature of the hypoglycæmic effect is determined by the rate at which the hormone is absorbed. In order to test this hypothesis, attempts have been made by us to mix Insulin with a casein-hydrolysate, "Pronutrin" (an enzymic digest of casein prepared by Herts Pharmaceutical Ltd., Welwyn Garden City, England) which contains a mixture of

simple peptides. Such combinations do not appear to have been given a trial.

We are briefly reporting the results obtained by a subcutaneous injection of Insulin (2 c.c. of 40 units/c.c., Lilly Co.) combined with casein-hydrolysate (2 c.c. of 2 per cent. 'Pronutrin') and zinc chloride (0·7 mg.). The resulting solution was adjusted to pH 3·4, with decinormal HCl; and it was found to be slightly opalescent. The proportion of zinc salt added has been kept more or less constant as in the two other Protein-Insulin preparations. Each of the preparations was tried on batches of 25 rabbits with 1 unit per rabbit.

Preparation injected	Average Blood Sugar (Mgm. per cent.)				
	0 hrs.	2 hrs.	4 hrs.	6 hrs.	24 hrs.
Ordinary Insulin ..	125·0	67·0	98·0	122·0	124·0
Protamine-Zn-Insulin	124·0	90·0	69·0	61·0	100·0
Globin-Zn-Insulin	124·0	68·0	72·0	85·0	107·0
Casein-Hydrolysate-Zn-Insulin	122·0	88·0	72·0	75·0	105·0

There appears to be a definite prolongation of the hypoglycæmic effect when Insulin is mixed with casein-hydrolysate. The intensity of the effect appears to be intermediate between those of Globin-Insulin and Protamine-Zn-Insulin. Further studies are in progress and the details will be published elsewhere.

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INDIAN HENBANE

Hyoscyamus niger or *Henbane* is a well-known medicinal plant which is extensively used for its sedative properties. In India the plant grows wild at an altitude of 5,000 to 9,000 ft. above sea-level in the temperate Himalayas. It has also been cultivated as a winter crop in the plains in such places as Saharanpur, Lyallpur, etc. In Kashmir the plant grows wild throughout the valley and on rubbish heaps, dry drains and outskirts of villages.

Although the supply of *Hyoscyamus niger* from Indian sources has been meeting to some extent the demand of the market in this country, yet it has been reported that the Hyoscyamus leaves from various localities in India are of poor quality,[1] much below B.P. standards.

Chemical analysis[2] of samples of leaf obtained in Kashmir Valley and other parts of India from both wild and cultivated plants was carried out. The leaves were collected at the flowering stage of the plant, dried partly in sun and partly in shade before analysis. The results are tabulated below:—

Locality	Altitude (ft.)		Percentage of total alkaloids
Drang (Kashmir)	7,500	Wild	0·076
		Cultivated	0·084
Yarikah (Kashmir)	7,100	Cultivated	0·074
Gulmarg (Kashmir)	9,000	Wild	0·066
N.-W.F.P. ..	3,000	Wild	0·047
N.-W.F.P. ..	1,100	Wild	0·031
Lyallpur ..	800	Cultivated	0·025
Saharanpur ..		Cultivated	0·035
Commercial samples of Kashmir-Grown Hyoscyamus (from Utilisation Division, Baramulia)			
1945 crop			0·058
1946 crop			0·062
B.P. 1932 standard			0·05
U.S.P. XII standard			0·04

The table shows that *Hyoscyamus niger* leaves growing wild or cultivated in Kashmir at altitudes of over 5,000 feet above sea-level give alkaloid contents well up to and even above B.P. and U.S.P. standards.

The leaf grown at lower altitudes or in the plains has a lower content than the B.P. and U.S.P. standard. The Forest Department of Kashmir State is planning to extend the cultivation of Hyoscyamus at suitable altitudes, and It is hoped that good quality leaves will be available to the medical profession on an extensive scale. So far the quantities of good leaf have been very limited.

We are grateful to Col. Sir R. N. Chopra for valuable advice in the course of investigation.

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VALUE OF $[M]_D$ FOR CAMPHOR-β-SULPHONATE ION IN WATER

Camphor-β-sulphonic acid is a strong acid and its salts easily ionise in water. For optically active substances which ionise in water Hadrich[1] offered the suggestion that in dilute aqueous solution they might ionise as follows:

$$R^* COOM \rightleftharpoons (R^* COO)^- + M^+$$
$$B^* HCl \rightleftharpoons (B^* H)^+ + Cl^-$$

where R* and B* are optically active acid and base respectively and the rotations of such solutions are due wholly to the anion in the former case and kation in the latter. Prior to this explanation Landolt[2] has shown that molecular rotations of Li, Na, K and NH_4 salts

	Camphor-β-sulphonates of :—		Temp. °C.	*d*-salt		*l*-salt	
				Conc. g./100 c.c.	$[M]_D$	Conc. g./100 c.c.	$[M]_D$
1	Ammonium[7]	..	35	1·0000	+51·05°	1·0016	−49·71°
2	*o*-Toluidene[8]	..	27–28	4·0032	50·86	4·0048	52·11
3	*m*-Toluidene[8]	..	29–30	4·0010	49·83	4·0060	51·19
4	*p*-Toluidene[8]	..	29	4·0040	52·88	4·0032	53·39
5	*o*-Chloraniline[9]	..	35	1·0016	51·98	1·0000	52·13
6	*m*-Chloraniline[9]	..	35	1·0000	55·72	1·0008	57·49
7	*p*-Chloraniline[9]	..	35	1·0008	53·91	1·0000	53·93
8	β-Napthylamine[8]	..	35	1·0000	54·96	1·0008	56·20
9	ar-tetrahydro-α-napthylamine[8]	..	35	1·0000	45·47	1·0016	47·19
10	Aniline[8]	..	26	4·0056	52·38	4·0044	51·36
11	*p*-aminobenzene-sulphonamide[7]	..	35	1·0016	52·46	1·0008	52·52
				Mean Value =	+51·96		−52·46

of *d*-tartaric acid approached the same value as the solutions were more and more diluted. Oudemans[3] had also obtained similar results with salts of quinine with different acids. Similar studies were carried out on metallic salts of *d*-camphor-β-sulphonic acid[4] by Thomas and Jones[5] and Graham.[6] These authors arrived at the mean value of $[M]_D = 52°$ for the camphor-β-sulphonate ion. The present author has examined a number of salts of *d*- and *l*-camphor-β-sulphonic acid with primary amines. The results are recorded in the table.

The mean value of $[M]_D$ for camphor-β-sulphonate ion, namely, $[M]_D = +51 \cdot 96°$ for *d*- and $[M]_D = -52 \cdot 46°$ for *l*-isomer agrees well with the value obtained by Graham for *d*-camphor-β-sulphonate ion. These results further indicate that primary amine salts of active camphor-β-sulphonic acids are more or less fully ionised in 1-4 per cent. solution in water at 26-35° C.

Further work on the degree of ionisation of salts of active camphor-β-sulphonic acids is in progress.

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CHROMOSOMAL CHANGES AND NUTRITIONAL REQUIREMENTS OF YEASTS

Changes in the chromosomal constitution of organisms have been known to produce changes in morphological and physiological characteristics.[1] Ever since the discovery of "bios" by Wildiers[2] a good deal of work has been done on the nutritional requirements of various strains of yeasts which has led to the discovery of a number of members of the B-complex vitamins. On the basis of their response to B vitamins, a classification of yeasts has been suggested.[3] But in yeasts, as in higher organisms, a rational approach to the problem of differences in biochemical characteristics should be based on chromosome and genetic constitution of the various strains. In this laboratory a brewery strain BY 1 was shown[4] to have two chromosomes and by treating it with acenaphthene, a tetraploid,[5] BY 3, and a mutant having two unequal chromosomes,[6] BY 2, have been isolated. The strains BY 1 and BY 3 are bottom yeasts while BY 2 is a top one. It was thought, therefore, that an elucidation of the changes, if any, in the vitamin requirements accompanying the changes in the chromosome constitution would be interesting.

The basal medium contained glucose 20 gms., salts solution 125 ml., citric acid citrate buffer of pH 4·5 100 ml., ammonium sulphate 4·0 gms., asparagine 100 mgm., acid hydrolysed casein 2·5 gms., tryptophane 50·0 mgm., cystine 100·0 mgm., thiamin, riboflavin, pyridoxin, nicotinic acid, *p*-aminobenzoic acid and calcium pantothenate 800 μg. each, biotin and folic acid 800 mμg. each, inositol 20 mg., and choline 1·0 mg. in one litre. 5·0 ml. of this medium was added to each of the flasks and sterilized at 15 lbs. pressure for 15 minutes. The inoculum was made by suspending the growth from a 24-hour wort-agar slant in 0·89 per cent. saline to give a concentration of 1 mg. of moist yeast per ml. and 0·2 ml. of this suspension was inoculated into each flask. After incubating the flasks at 28° C. for 21 hours, the growth was measured with a Lumetron turbidometer.

The observations indicate that for BY 1 and BY 3 inositol, thiamin, pantothenate and biotin are absolutely essential and that pyridoxin is an accessory factor under the conditions employed. Both these strains show no growth in the absence of all the vitamins. Riboflavin and choline have an inhibitory effect on all the three strains. The similarity of the response of the tetraploid, BY 3, to that of the control strain, BY 1, is not surprising since that is what should be expected if a mere duplication of the chromosomes is unaccompanied by any gene mutations.

TABLE I

Growth expressed as percentage absorption after 21 hours

Medium		–Thiamin	–Riboflavin	–Pyridoxin	–Nicotinic acid	–Pantothenate	–p. amino Benzoic acid	–biotin	–inositol	–Folic acid	–Choline	All vitamins	No vitamins
BY 1 Control	..	4·0	100	38·5	78·0	2·5	87·5	17·5	1·5	86·0	100	84·5	0·5
diploid, bottom yeast	..	4·0	100	40·0	75·5	2·0	83·0	19·0	1·0	87·5	98	80·5	0·5
BY 2 mutant	..	38·0	100	56·0	60·0	61·5	61·0	30·0	67·0	62·0	100	72·0	26·0
top yeast	..	36·0	99·5	57·5	58·0	58·5	59·0	27·0	65·0	64·5	96·0	68·0	27·5
BY 3 tetraploid	..	1·5	99·5	20·5	89·0	2·5	83·0	9·5	0·0	89·0	93·5	85·5	0·0
bottom yeast	..	0·0	100	26·0	91·0	1·5	82·5	12·0	0·0	83·0	95·0	85·0	0·0

The behaviour of the top yeast, BY 2, is highly interesting. The fact that on no vitamin medium the growth is about one-third of that in an all vitamin medium indicates that the mutation is a dominant one. From cytological investigations it was suggested by Subramaniam and Ranganathan[6] and Subramaniam,[7] that the change may be the result of the deletion of a bit of one of the chromosomes. The growth in the medium without biotin and without thiamin is about the same as that in no vitamin medium. Quite unlike BY 1 and BY 3 this strain grows well on media lacking pantothenate or inositol, which means that on becoming a top yeast, it has either acquired the capacity to synthesize the above factors or that it may not require them for growth at all. . So, this relatively auto-trophic nature of the mutant indicates that it is not the case of a mere "pseudo dominance" of the remaining haploid set of genes in the normal chromosome. The work of Beadle[1] and his collaborators indicates that a mutation of a given gene implicates a particular enzyme. Judged on that basis, if the mutant top yeast is really the result of a chromosomal deficiency, it ought to have been accompanied by a few gene mutations. From published literature on the effect of acenaphthene on higher plants such a possibility appears to be remote. The probability, however, is a duplication of some genes in one chromosome accompanying the deficiency in the other. Winge and Laustsen[8] suggested that the difference between bottom and top yeasts is a quantitative and not a qualitative one. If that is so, then, the remarkable behaviour of the mutant top yeast, BY 2, is likely to be the result of a "position effect" accompanying the duplication of some genes. Occurrence of "position effects" has been demonstrated not only in animals[9] but also in plants.[10] Hence the occurrence of a "position effect" in yeast in which the chromosomes show "somatic pairing" as in Diptera, is not very surprising.

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ON THE PREPARATION OF PURE CULTURES OF *VORTICELLA*

Two methods have been generally followed with regard to the cultivation of protozoa in a medium containing killed or living bacteria The older method[1] consists in streaking agar plates radially or by central circular smear with the bacterial strain upon which the protozoa are to be nourished. The later method[2] consists in replacing the bacteria associated with the protozoan by a specific strain of bacterium through change of the medium.

For freeing the protozoa from the adhering bacteria five principal methods have been employed: (*a*) desiccation of cysts,[3] (*b*) sterilisation of cysts employing chemicals[4,5] and heat,[6,7] (*c*) washing the cells in sterilised water,[8] (*d*) negative geotaxis,[9] and (*e*) cataphoresis.[10]

The method adopted by us for the separation of *Vorticella* sp. from the contaminating bacteria and the attempts made to culture the bacteria-free *Vorticella* in synthetic media are briefly described in this communication. The method[11] is based on the fact that the protozoa exhibit a geotropic response by virtue of

which the protozoa swim away from the adhering bacteria when taken through columns of sterile liquid in V-tubes or suitable pipettes.

Heat-sterilised pipettes (16-18" long and ¼" bore) having a tapering point and rubber tube with cotton plug and pinch cock at the large end were used for the present studies. The pipettes were filled with sterilised tap water to within 2" of the top by suction. About 2 c.c. of the culture of *Vorticella* sp. originally isolated from aerated sewage samples was carefully sucked up into the pipette so as to form the layer beneath the sterile water. The tapering end of the pipette was then sealed by heat, taking care to prevent the formation of air bubbles. The rubber tube with cotton plug attached to the pipette was then removed aseptically and some heat-sterilised yeast cells were carefully placed on the water layer and the rubber tube with the plug put back in its place. The pipette, sealed end down, was set upright in a test tube. Under these conditions even motile bacteria by their own efforts cannot reach the top in the given time. The *Vorticella* were found present at the top of the water column in about half an hour after allowing the pipettes to stand. The pipettes were left like this for 24 hours, thus giving a chance to the suface migrants to evacuate the remains of ingested microbes and to feed on the yeast material at the top of the water column. This procedure was repeated, sucking up each time beneath the fresh column of sterilised water in a fresh sterilised pipette, about 2" of fluid from the top of the previous pipette, until the top fluid containing the protozoa was free from bacteria as shown by negative results in broth cultures. This was usually accomplished after three washings. The addition of sterilised yeast cells to the top of the water column was found useful as it accelerated the migration of the protozoa.

Having obtained bacteria-free cells of *Vorticella*, attempts were made to grow them, under aseptic conditions, in artificial media. A number of media (such as the basic medium of Glaser and Coria[12] containing horse-serum and timothy hay extract, and the synthetic medium of Pringsheim[13] containing small amounts of potassium phosphate, potassium chloride, potassium carbonate, sodium acetate, magnesium sulphate, peptone, gelatin and dextrose), successfully employed by other workers for the cultivation of other forms of protozoa (such as *Trichoda pura, Chilomonas paramœcium, Polytoma uvella, Euglenida* and *Phytomastigophora*) were tried for the *Vorticella* sp., but the growth of this protozoan in these media was found very poor. Similar observations were made by Luck and Sheets[9] in regard to *Euplotes* and by Glaser and Coria[12] in regard to *Paramœcium caudatum* and *P. multimicronucleatum*.

Vorticella, like certain other forms of protozoa, apparently require special growth-promoting substances which are presumably available under natural conditions of their development. It is of interest in this connection to note that pantothenic acid has been found to stimulate the growth of *Glaucoma pyriformis*[14]; that certain of the plant hormones have a marked beneficial effect on the growth of *Euglena gracilis*[15]; that thiamin or pyrimidine has been found necessary for the growth of *Acanthamœba castellani*[16]; and that ascorbic acid as well as hæmetin and other yet unidentified factors have been found to influence the growth of *Trypanosoma cruzi*.[17] In view of these observations, it would be of great interest to study the nutritional requirements of *Vorticella* and other forms of protozoa which have a vital role in sewage purification and allied processes.[18,19]

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NICKEL-THORIA-KIESELGUHR CATALYST FOR THE FISCHER-TROPSCH REACTION
PART I

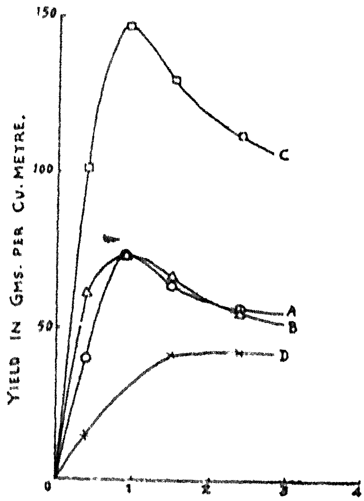
In industrial practice in Germany, cobalt has been mostly used for Fischer-Tropsch Synthesis; nickel has not found much use though it is very much cheaper as it favours formation of methane and deteriorates rapidly. Chakravorty[1] considers that such deterioration is due to the traces of alkali ion present in the system. This idea has been followed up, and a catalyst has been prepared by using ammonium carbonate as the precipitant in presence of excess of carbon dioxide.

Kieselguhr, purified with HNO_3, is added to requisite quantities of thorium nitrate solution and 20 per cent. excess of nickel nitrate solution, and stirred vigorously. Carbon dioxide is passed into the solution and dilute ammonium carbonate solution added drop by drop with stirring till a faint smell of ammonia is obtained. The precipitate is filtered immediately through a Buchner funnel and washed with distilled water, dried at 110° C. and broken into granules which pass through 8-mesh but are retained by 12-mesh. The catalyst is then reduced at 500° C. for 6 hours in a current of hydrogen, prepared electrolytically.

The catalyst (5-6 c.c.) is then charged into the reaction chamber and again reduced *in situ* at 300-350° C. in a current of H_2 for 6 hours, and the synthesis gas is passed through the catalyst. Reactions are carried out at different temperatures and at different space velocities.

The products of reaction are passed through a glass condenser, cooled in ice where liquid hydrocarbons and water are condensed and then through four glass-stoppered U-tubes, first containing soda lime to absorb CO_2, and the rest containing active carbon cooled in ice, for absorbing gaseous hydrocarbons. The products of the cooled glass condenser are analysed for water by the method adopted by Smith and Bryant.[2]

It was observed that the best reaction takes place at 195° C. The catalyst is remarkably steady at that temperature. The results are illustrated in Fig. 1.



SPACE VELOCITY.
(LITRES/HR./GM. OF NICKEL)
A — LIQUID HYDROCARBONS.
B — GASEOUS HYDROCARBONS. } EXCLUDING METHANE.
C — TOTAL HYDROCARBONS.
D — METHANE

From the graph it is observed that the catalyst yields at atmospheric pressure, 147·5 gms. of hydrocarbons, excluding methane per cubic metre of synthesis gas with a space velocity of 0·90 litres per hour per gram of nickel in the catalyst which compares well with that used in industrial practice.

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NOTE ON THE DETERIORATION IN GERMINATION-CAPACITY OF A PADDY STRAIN IN MALABAR AND SOUTH KANARA

SOME varieties of rice seeds like *Garikesannavari* of the Godavari delta and the *Boro* rices of Orissa, are found to lose viability if they are stored in receptacles which are not airtight, like loose gunnies, straw-twist bundles or cloth bags.

More or less the same type of deterioration was noticed a few years ago in the case of Co. 3 strain (Coimbatore *Vellai samba*) cultivated in Malabar and South Kanara, where it is sown in August-September and harvested in December-January. Locally the harvested grains are dried and stored in straw-twist bundles or other non-air-tight receptacles till the time of next sowing in August-September. The seeds thus pass through the wet weather period of the south-west monsoon which usually records about 60 to 80 inches of rain in the two months of June and July and deteriorate as indicated by low germinability unlike those preserved in metallic or air-tight receptacles.

In the course of an investigation to find out a simple and effective method of overcoming this defect, it has been possible to establish a fairly close correlation between the deterioration in the germination and the capacity of the grains to germinate immediately after harvest, with a value for $r = +0{\cdot}7968$.[1]

The kernels of the deteriorating types have, besides, a flinty appearance; they expand better on cooking immediately after harvest than non-deteriorating types. In the dry state as seed, they show a marked capacity to absorb more moisture. These facts would suggest that they might have undergone a process of intense desiccation in the field during the maturing phases of the grain.

It is common observation that in rice, the ripening of the grain and the ripening of the foliage do not always go together; in some varieties earheads ripen while the straw is still green, while in others the two processes synchronise; in still others the straw ripens and lodges before the grains reach full maturity. Thus the ripening of the ear and the attendant transformations of the contents in the grain might be independent features conditioned by atmospheric humidity, intensity of sunlight, diminishing supply of water, etc. Continual decrease of the water content is a significant feature of this process of ripening; even the important role of enzymes may be conditioned, above all, by the amount of moisture the grain holds at successive stages of dehydration which in turn might determine the nature and proportion of the different carbohydrates in the grain at the time of harvest.

This line of thought suggested that if the process of hydration and dehydration taking place in the ripening grains on the plant, is followed on after the harvest of the grains also, gradual dehydration could be induced in contrast to rapid desiccation and the defects of the seeds could be got over.

From the results of a series of experiments conducted with different periods of soaking and

drying, it is seen that deterioration could be very successfully checked if the seeds are soaked in water for about 5 minutes and immediately dried, taking care to see that they do not dry to excess. From 80 to 100 per cent. germination was obtained this way while the control gave only 12 to 30 per cent. The treatment, as simple as it is effective, does not affect the yield, either of grain or straw, of the succeeding crop.

Pan[2] has found that seeds soaked in a 2 per cent. solution of copper sulphate for a short time, dried and stored, kept their viability longer but the rate of germination was slow. On the basis of the above results it might be that it is the action of water that had induced longer viability in these experiments.

The effect of water treatment may be purely a physical one—a mere 'hardening' process, or it may be the result of an increase in hygroscopic moisture which is not lost on subsequent drying, in which case, the results so far obtained would indicate that seeds with minimum hygroscopic moisture keep well in quite air-tight receptacles while in aerobic storages, more hygroscopic moisture is needed. Thus a certain relationship would seem to exist between the moisture in the seed and the atmospheric humidity acting on it in storage.

Saran[3] working on the viability of paddy seeds has observed (1) that seeds which contained 10 to 12 per cent. moisture at the time of storage deteriorated even in air-tight receptacles, (2) that they remained viable in receptacles with desiccating agents and (3) that the same seeds kept up viability without desiccating agent when the moisture was brought down, by drying, to 3·6 to 4·5 per cent.

These observations lend support to the view that for successful storage, the seed and its environment have to be in a certain equilibrium as regards moisture content. Based on the ratio of the humidity of the surrounding atmosphere and the internal moisture content of the seed it may be possible by extensive and well-planned experiments to establish a general law governing its germination.

Though it has been possible to solve the problem of deterioration by a simple treatment, the internal background, genetic and physiological, that might differentiate the deteriorating and the non-deteriorating types, remains to be investigated.

Sreenivasan[4] has suggested that the activity of the α-amylase in rice grain has a close relationship to the extent of swelling on cooking. This swelling capacity would seem to be positively correlated with the germinability of the seeds immediately after harvest, which in turn has a direct relationship to the extent of deterioration in aerobic storage. It is quite probable that the expansion on cooking and immediate post-harvest germinability are determined by the nature of the starch complex in the grain. A study, therefore, of the different carbohydrates and their proportions as also the enzymic activity in the maturing endosperm of the different varieties of rice might throw much light on this problem of deterioration.

The lines of investigation indicated above are being pursued and a full report will be published in due course.

P. C. SAHADEVAN.
M. B. V. NARASINGA RAO.
Agri. Research Station,
Pattambi,
May 28, 1947.

1. Ramiah, K., "Rice in Madras," 1927. 2. Pan, C. B., *J. Amer. Soc. Agron.*, 1936, **28**, 985. 3. Saran, A. L., *Curr. Sci.*, 1945, **10**, 271. 4. Sreenivasan, A., *The Indian Jour. Agri. Science*, 1938, **9**, 208.

SOME NEW HOSTS FOR *STRIGA*

THE members of the genus *Striga* are parasitic on many graminaceous plants, some of which are important food crops. Of these, *Striga densiflora* and *S. lutea* have been known to attack sorghum (*Sorghum vulgare*) in this province. In Bombay Province they are reported to parasitise on crops of the Italian millet (*Setaria italica*) and Bajra (*Pennisetum typhoideum*) also.[1] Sugarcane is attacked by *S. euphrasioides* and *S. densiflora* in India[2] and *S. hirsuta* and *S. parviflora* in Mauritius.[3] Besides sugarcane, *S. euphrasioides* is found on rice also.

No instance has so far been reported in Madras of the parasitism of *Striga densiflora* on Italian millet. In January 1947, the author came across a heavily infected crop of *Setaria*

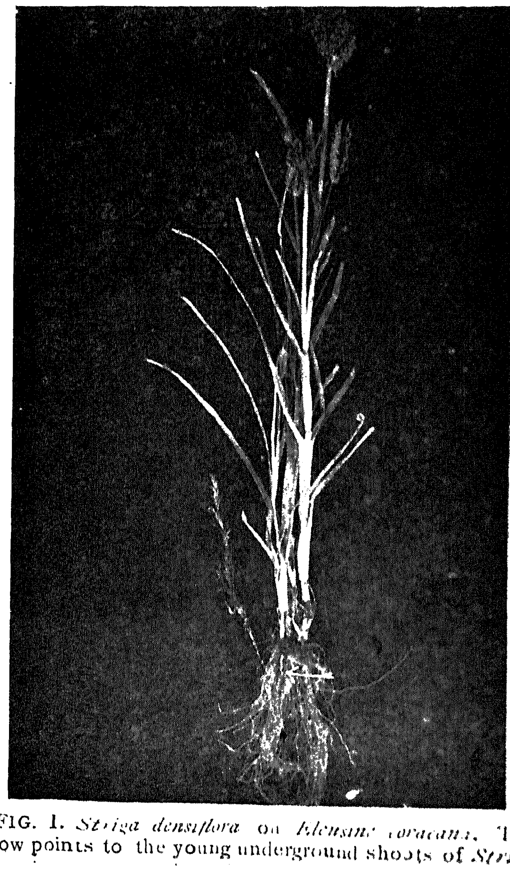

FIG. 1. *Striga densiflora* on *Eleusine coracana*. The arrow points to the young underground shoots of *Striga*

italica in a field of the Central Farm, Coimbatore. The species of parasite, involved was almost exclusively *Striga densiflora*. An observation made at this time was the attack of *Striga densiflora on Ragi* (*Eleusine coracana*). A few stray ragi plants were found in a field of Italian millet with *Striga densiflora* growing quite close to them. When these were dug up with the earth surrounding them and carefully washed, it was found that the *Striga* had well-formed connections with the ragi plants. One or two of the underground shoots of *Striga* were also found. Fig. 1 shows the aerial shoots of *Striga densiflora* and a small underground shoot among the roots of the ragi plants.

The occurrence of *Striga* on ragi has been observed by Coleman[4,5] in Mysore as early as 1916, but the species of parasite involved has not been mentioned. However, in a recent account of the diseases of ragi,, Venkatarayan[6] has recorded *Striga lutea* as the parasite affecting this crop in Mysore. Another species of *Eleusine, E. œgyptiaca* (*Dactyloctenium œgyptiaca*) was recorded as a host of *Striga densiflora*.[1] But as this grass is no longer considered to be a member of the genus *Eleusine*, but is included under *bactyloctenium*, the present record appears to be the first authentic case of the parasitism of *Striga densiflora* in the genus *Eleusine*.

Other Hosts :

Striga densiflora was found parasitising the following grasses also, *Brachiaria eruciformis* Griseb. (*Panicum isachne* Roth.), *Tragus racemosus* Scop., and *Eragrostic Willdenoviana* Nees. Of these, the specie of *Eragrostis* has

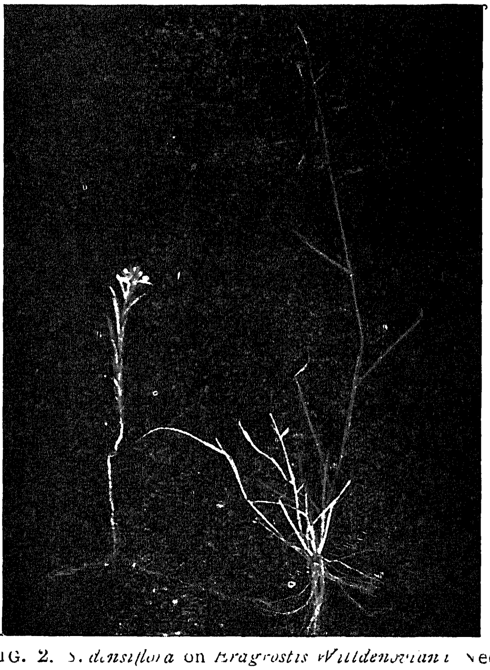

FIG. 2. *S. densiflora* on *Eragrostis Willdenoviana* Nees.

not been reported as a host of *S. densiflora*. Though Van Burren[7] has recorded a specie of *Eragrostis* as a host of *S. densiflora*, he has not mentioned the exact specie. Fig. 2 shows the parasitic connections between *Striga* and *Eragrostis*.

A new host for *Striga lutea* was discovered among the fallow plots surrounding the Research Institute. This was a grass, *Tragus racemosus* Scop., which has so far been known

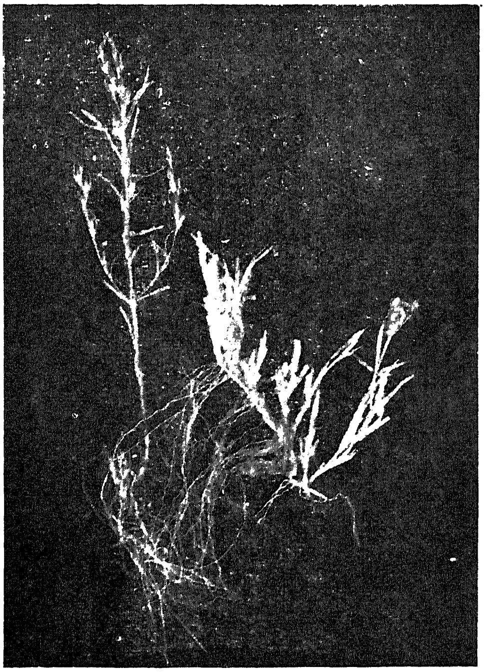

FIG. 3. *Striga lutea* on *Tragus racemosus* Scop.

to be the host of *Striga densiflora* only[1] (Fig. 3).

I.C.A.R. School in Mycology,
Mycology Section, A. R. SRINIVASAN.
Agri. College & Res. Institute,
Lawley Road P.O.,
Coimbatore,
July 20, 1947.

1. Kumar, L. S. S., and Solomon, S., *Proc. Ind. Acad. Sci.*, B, 1941, **13**, 151. 2. Luthra, J. C., *Agri. J. India*, 1921, **18**, 519. 3. Bell, A. F., and Cottrell-Domer, W., *Queens. Agrl. J.*, 1931, **36**, 463. 4. Coleman, L. C., *Rept. Agr. Dept. Mysore*. 1916–17, 1917. 5. –, *Dept. Agr. Mysore State, Gen. Ser. Bull.*, 11, 1920. 6. Venkatarayan S. V., *Mysore J. of Agri*. 1946, **24**, 56. 7. Van Burren, H. L., *Poona Agrl. Coll. Mag.*, 1915. **5**, Nos. 3 and 4.

VIVIPARY IN *PYRUS MALUS*

VIVIPARY is a common phenomenon in the mangroves and jack fruit. It has also been reported to occur in mangoes and some grasses.

An apple was purchased at Cuddapah, and the fruit looked quite healthy but not heavy. When the fruit was cut open the outer fleshy portion was found to be spongy. Inside there were 8 healthy seedlings and 2 seeds. The length of the seedlings was about one inch. The broken testa was in tact and all the seedlings were loosely attached to the central axis. The apple was not at all sweet as the seedlings had evidently utilised much of the sugar for their germination and growth.

Agri.-Met. Section,
Meteorological Office,
Poona, V. K. S. MANI.
August 27, 1947.

REVIEWS

Chemistry of Muscular Contraction. By A. Szent-Gyoryi. (Academic Press Inc., N.Y.), 1947. Pp. 150. Price $ 4.50.

Modern Physiology of Muscle may be said to have begun the classical experiments of Fletcher and Hopkins in 1907. But their theory that formation of lactic acid from glycogen was the initial event in the activity of muscle and that lactic acid, acting upon the contractile substance, was responsible for initiating the contraction, could not be sustained in the light of subsequent discoveries, even though the glycogen—lactic acid conversion has been confirmed and found to be the main energy-yielding mechanism, and further details regarding the enzymatic breakdown of glycogen have been established by the later brilliant work of Meyerhof, Embden, Warburg, Von Euler, Lundsgaard and others. With the discovery of phospho-creatine in muscle by the Eggletons and Fiske and Subba Row, in 1927 and of adenosine-triphosphate (ATP) by Lohmann in 1928, there was, in A. V. Hill's words, "a revolution in muscle physiology". The important role of these phosphorus compounds in the contractile process and in glycolysis and the part played by the carbohydrate cycle in the resynthesis of phosphorus compounds have since been demonstrated by Lundsgaard, Parnass and others. The conception that energy associated with a chemical compound can be transferred without loss and utilised for work is a new one in modern physiology.

Though we have at the present day detailed information regarding the chemical changes in muscle, the essential nature of the contractile mechanism is still a mystery. What is the nature of the contractile element? How does the contractile element become active? Is the energy of contraction derived from the chemical stores or from the potential energy of the contractile element itself? Is chemical energy drawn upon for relaxation also? These are all questions that have to be answered to know exactly how a muscle works.

Szent Gyorgyi, Bio-chemist, University of Budapest, has, in his recent excellent monograph on "Chemistry of Muscular Contraction" dealt with these problems in a very lucid manner referring to the recent advances and incorporating the results of his own valuable research work on the subject. As an expert Bio-chemist, he has pulled the muscle fibre to pieces and has thrown much light on its exact composition and behaviour. He has attempted to link the chemical processes in muscle with the mechanical changes and has shown the intimate relationship between ATP and myosin, the chief protein in muscle. He describes that myosin itself, in combination with 'actin', a new protein discovered by F. B. Straub in 1942, shows enzymatic properties and acts on the adsorbed ATP in a narrow range of KCl concentration in the presence of Mg ions. The adsorption of ATP is dependent on K adsorption which in its turn depends on the previous adsorption of bivalent ions. Buchthal and others discovered in 1944 that ATP applied to isolated muscle fibre produces twitches or tetanus. It is considered that under certain conditions the release of one single K ion may start the auto-catalytic release of the adsorbed ATP which sets up further changes. Possibly the ATP released in one muscle micel starts the process in its neighbour. According to Szent-Gyorgyi, the contracted state of 'actomyosin' is energy-poor and dehydrated, and in this state becomes enzymatically active, splits ATP and derives energy to go back to the energy-rich, hydrated, relaxed state.

Based on the recent findings of Boros and others about photo-electric effects and phosphorescence in a series of proteins caused by particular association of particles and establishment thereby of a common electronic band-structure stretching over the whole system, Szent-Gyorgyi puts forward a theory called 'the continuum theory' which, he considers, explains how 'actin', 'myosin', and prosthetic proteins, united into a complex, develop entirely new qualities of contractility or enzymatic activity and also how by the electron transport system the 'actomyosin' is linked to the 'oxidases' and 'dehydrogenases' which play a very important part in the oxidative reactions in muscle. He opines that 'the continuum theory' may take us even one step further into mysterious domains like that of origin of life.

The author deserves great credit for elucidating the intricate problems of muscle physiology in the light of recent research work and for introducing fresh ideas which, it is hoped, will stimulate further work on the subject. The monograph is a very valuable addition to the literature on muscle physiology.

B. T. Krishnan.

Muscular Contraction. *Annals of the New York Academy of Sciences*, Vol. XLVII, Art. 6, pp. 665-930.

This volume contains an interesting series of papers on the physiology of muscular contraction. It is divided into four parts. Part I deals with the dynamics of muscular contraction. The study of single muscle fibres presents a recent approach to the elucidation of the properties of muscular contraction. The comparison of rubber with muscle is interesting. At present we are ignorant of the chain of events which connect the muscle membrane and the contractile elements; the attempt, therefore, to point out at least one approach to this question, namely, the relationship between membrane changes and initiation and maintenance of contraction is interesting.

Part II contains articles on the ultrastructure of muscle. Birefringence, electron microscope, and X-ray diffraction studies contained therein offer their independent approaches to a visualisation of the ultrastructure of muscle, the structural basis of the muscle machine being of utmost importance for any theory of the contractile mechanism.

Part III contains articles on the latest views regarding the chemistry of muscular contraction.

Part IV deals with the problems of mechano-chemical coupling, originating from the finding of Engelhardt and Ljubimova that myosin is itself an enzyme, and could no longer be regarded as an inert protein serving merely as the building blocks of the muscle fibril, but is, in all probability, a functional basis for the muscular activity.

Muscular contraction, however, still remains mysterious.

INDERJIT SINGH.

Vegetable Growing. By J. S. Shoemaker. (John Wiley & Sons, Inc., New York), 1947. Pp. 496 *plus* Index. Price $4.50.

Vegetable growing is one of the important divisions of the science of Horticulture and is now conducted on a very large scale as a specialised type of farming rather than as mere gardening. In almost every country a great impetus was given to the cultivation of vegetables particularly green vegetables whose health value is recognised during the prolonged emergent conditions through which the whole world went through in recent years. The publication of the book under review is timely and very helpful as it pertinently acquaints the vegetable grower the application of such scientific principles and facts involved in successful production and maintenance of vegetable crops. Since a good vegetable cultivation primarily depends on the nature of the seed used, the author at the outset has laid a special emphasis on seed production practices so that there will be a better understanding of the fundamental factors involved in raising quality seeds. In the subsequent chapters (2-14) we are given a lucid and an eminently practical account of the different kinds of vegetables grouped as under:—Perennial vegetable crops, Corn crops, Root crops, Pulse, Bulb, Salad, Green and Cole crops. Potato, Sweet potato, Solanaceous fruits and Vine crops. An interesting historical account of most of the vegetables is given. The characteristics of the plant, the mode of planting, kind of soil, and the site necessary are described. Manures to be used and frequency of irrigation are indicated. Under cultivation and care, the pitfalls to be avoided and the essential cultural practices are clearly explained. The process of harvesting, the preparation for marketing are enumerated. The common diseases and pests to which each vegetable is prone are mentioned and remedial measures suggested.

The book is extremely well got up and is of that high standard that one has come to expect of its publishers. *Vegetable Gardening* is profusely illustrated, contains a good index and a number of references. Prof. Shoemaker has succeeded in making *Vegetable Growing* both a science and an art. The book should prove to be a welcome companion to vegetable growers and more especially to students of horticulture.

L. S. D.

The Nature and Prevention of the Cereal Rusts as Exemplified in the Leaf Rust of Wheat. By Chester K. Starr. (Waltham, Mass.: The Chronica Botanica Co. Calcutta: Macmillan & Co., Ltd.), 1947. Pp. xvi + 270. Price $5.00.

This book came to our hands at a time when the rusts had taken a heavy toll on the Indian wheat crop. As the title indicates, the book is a monograph on *Puccina triticina*; it is a welcome addition to the literature on rusts. Those who have not had an occasion to go through the Russian monograph by Naumov will find in Prof. Chester's work all that one needs to know about the rust, including the more complicated aspects of rust control and breeding for rust resistance. The time was indeed ripe for such a monograph, not only on the brown rust but also on black and yellow. The author has admirably filled in the first gap and told a coherent story of the rust, many parts of which throw an illuminating light on the rust problem in general.

The author approaches the rust problem from the standpoints of a botanist, plant pathologist and plant breeder, with exceptional documentation on the leaf rust. The study begins with a short description of the origin and history of the cereal rusts and surveys the economic importance of the leaf rust in more than forty countries. It seems desirable that the paramount importance of this rust as concluded from Table I may be supported by similr tabulation of comparable data with regard to the yellow and, especially, the black rusts. Then follows a mass of information on the outstanding developments in the various aspects of rusts and on our understanding of the etiology, symptomatology, physiological specialization, rust survival, and rust control by fungicides as well as by the development of inherent rust resistance. More than three decades ago, experimental pathologists established the fundamental technique of the study of the physiological specialization of rusts; their work revealed the existence of physiologic races and opened the way for further advances by mycologists, geneticists and biochemists. In the two chapters on physiological specialization are discussed the concept of Geshele's "Isoreagent", the mesothetic reaction and refinements of the differential host technique with regard to the various factors influencing the host and pathogen in the determination of biologic races. Among the main recommendations are the advisability of adopting standard cultural conditions in rust analysis, maintaining an international collection of type cultures, and eliminating the three unstable of the eight differentials for brown rust analysis which would result in reducing the number of races of this rust from 129 to 44. Plant breeders will find of particular interest the evidence given in favour of the *environmentally conditioned race groups*. It is, however recognised that the problem of breeding for rust resistance is complicated by the shifting nature of rust races and advent of new ones. The position will improve only when, as recently suggested by Stakman, are discovered the scientific principles underlying the prediction of potential races.

The monograph on the whole is an authoritative account of the rust problem as it stands to-day. The tables, the method of presenting the data, the readability, and the unusually good indexes add to the quality of the monograph. It is comprehensive and has covered the important work done in this country. India became rust-minded a generation ago, thanks to the work initiated by Mehta; and a co-operative breeding programme was started later by

Pal and Mehta. In the present state of our knowledge breeding for rust resistance and extending acreages under rust-resistant varieties seems to be the only suitable means of defence in most of the wheat belt. Prof. Chester has adduced evidence from India, Russia and other countries to show that rust uredospores can travel over great distances, sometimes over 1,000 miles, and has rightly pointed out that this is an international problem which can only be solved by international co-operation. We are in an age when the value of team-work for solving urgent scientific problems is increasingly clear. It is to be hoped that an international organization, as for instance, the Food and Agriculture Organization of the United Nations, which has kindled so many hopes in recent times, will take up this problem and bring a solution to it for the benefit of the world's population.

G. T. KALE.

Report of the Scientific Advisory Board of the Indian Research Fund Association for the Year ending 31st December 1946. (The Secretary, Governing Body, Indian Research Fund Association Secretariat, New Delhi.) Price Re. 1.

The Report is an interesting record of work on various subjects of medical and public health importance including nutrition.

Notable contribution has been made to malaria problems by experimental transmission of Simian Malaria *P. cynomolgi* to *Macaca muletta* monkey at Kasauli Institute to a number of species of anopheline mosquitoes which were experimentally infected.

On the therapeutical side paludrine has been found far superior to mepacrine, and in the case of malignant tertian malaria by suitable dosage the disease can be completely cured or effectively prevented.

It has been exclusively shown that in neuroleprosy nasal smears show *M. lepræ* in much smaller proportion than skin smears, this is contrary to accepted notion. Promin and diasone, two sulpha drugs, have given encouraging results in the treatment of leprosy in the hands of Dharmendra.

Casein hydrolysate vaccine for plague prophylaxis is found to have better keeping qualities than vaccine prepared by other methods and, therefore, it has longer expiry date. Among plague-prevention measures cynogas is more effective than D.D.T. to kill rats and fleas.

Radhakrishna Rao has evidence to suggest the role of low protein diet combined with vitamin B_2 complex deficiency as causative factor in infantile cirrhosis.

Clinical studies of Kutumbaiah indicate that the disease is more prevalent among children of low income group without any distinction of community. Cow's milk seems to play a part in the causation.

Lowe's finding of hypoproteinæmia in Kala azar is of diagnostic significance. Similar condition has also been noted in diseases of the liver and tropical Eosinophelia. It has been observed that the protective power conferred by vaccinia virus cultivated in egg membrane is of shorter duration than that conferred by ordinary calf lymph. But during the period of protection there was no incidence of smallpox in an epidemic of smallpox in a village where two groups of children were vaccinated one group with calf lymph and the other with membrane lymph.

Pyrithrin content of pyrithrum flower grown in different localities of Kashmir and dried by different methods has been studied with valuable findings by Chopra. The same author has made important observation on the deterioration of tincture digitales and powdered digitales leaves.

On the side of nutrition extensive work has been done. Ghosh in Calcutta states that vitamin C synthesis by rat will depend on the availability of thiamin and riboflavin in the system. Vitamin B complex deficiency is said to be the commonest form of malnutrition observed among patients in Madras hospitals, the clinical manifestations of which are various. Rapid improvement has been observed in cases of anæmia, œdema and cirrhosis of liver when treated with high protein diet. Muscle protein has been found to raise hæmoglobin and R.B.C. level higher than by liver protein. Properly prepared soya milk fortified with calcium and yeast has been credited to be superior to cow's milk as a supplement to poor rice diet. The vitamin content of pure-bred cereals has been shown to be greater. This finding emphasises the influence of genetic factor over the environmental factor in the determination of quality of cereals.

K. P. M.

Journal of Indian Medicine (Quarterly Journal) Nandakutti Bldgs., Besant Avenue, Adyar, Madras—20). Annual Subscription Rs. 3.

The first number of this Journal, published from Madras, is commended to those of the medical profession interested in ancient medicine. The Journal begins with a descriptive definition of Ayurveda. There are interesting articles on anæmia and fevers. There is a treatise on the treatment of snake-bite besides a few clinical notes by practitioners. It is hoped that the Journal will prove to be an useful contribution to the advancement of the indigenous medicine which is now being revived.

K. P. M.

Heredity. An International Journal of Genetics. (Oliver & Boyd Ltd.), 1947. Annual Subscription 40 *sh*.

The advances in Genetics during recent years have been phenomenal. This is not surprising since Genetics to-day fascinates not only the biologist and the statistician but also the chemist, the bacteriologist and the physicist as well. Originating as a branch of biology, it has become a science in itself. In fact specialization in certain directions in this field has gone so far that workers in other branches may find it difficult to follow and appreciate the recent advances.

But the increased interest in Genetics has not been accompanied by an increase in the number of Journals specially devoted for contributions on the subject. We have much pleasure, therefore, in welcoming the first number of *Heredity*, published thrice a year, edited by Dr. C. D. Darlington and Prof. R. A. Fisher in collaboration with a number of leading Geneticists. If the contributions expected to appear in the succeeding issues are any indication, the Journal has a promising future.

M. K. SUBRAMANIAM.

SCIENCE NOTES AND NEWS

Jubilee of the Electron

The Indian branch of the Institute of Physics (London) and of the Electrical Engineering Society, Bangalore, celebrated the Jubilee of the discovery of the electron at the Indian Institute of Science, Bangalore, on the 25th and 26th September. The celebrations were organised by the President, Sir C. V. Raman. On the 25th evening addresses were delivered by Sir C. V. Raman on the "Discovery of the Electron" and by Prof. R. G. Harris on "Reminescences of Sir J. J. Thompson" under the presidentship of Sir J. C. Ghosh. On the second day Sir C. V. Raman spoke in detail about the recent developments in the application of electron with reference to Radar, Electron Microscopy and Television, and Prof. R. G. Harris presided.

Indian Archives

The National Archieves of India (Imperial Record Department) has taken up the publication of an illustrated quarterly journal entitled the *Indian Archives* for the dissemination of information on archival and library matters.

The object of the journal is to pool up the knowledge on the use and preservation of historical material and render it accessible to a wider circle of readers who may find it useful. The quarterly will, on the one hand, serve as an organ for the furtherance of improvements in the field of archives-keeping by publishing the results of research by specialists in the subject and on the other help to keep all those interested in the science informed of the latest contributions made to it in the progressive countries outside India. One entire section of the journal will be devoted to publishing extracts or translations of significant articles on the subject in foreign languages not easily accessible to Indian readers.

Tin and Its Uses

The use of an extremely thin coating of tin (0·00005" thick) on mild steel before painting is found to provide an exceptionally good rust-resisting combination. An even more important finding is that the pre-tinned specimens have retained a clean tinned surface which is free from rust and can be re-painted without preliminary scraping and cleaning operations whereas the surfaces of the untinned steels rust underneath the paint. The use of pre-tinned steel would do much to improve the appearance and prolong the life of motor car body-work and other painted steel products. The costs involved in applying an undercoating of tin, of the recommended thickness (0·00003-0·00005 inch), to both surfaces of a sheet of steel are estimated at less than a quarter of the charges for labour and materials required to apply a single coat of paint to only one side of the sheet.

Tin and Its Uses, No. 18, may be obtained free of charge on application to the Tin Research Institute, Fraser Road, Greenford, Middlesex, and in the United States from the Battelle Memorial Institute, 505, King Avenue, Columbus, Ohio.

Exhibition of Deep Pictures

A very interesting exhibition of three-dimensional photography was held at the London Exhibition Centre recently. On view were a number of flat photographs which give to the spectator a very effective three-dimensional impression of various subjects without the use of any of the apparatus used with ordinary stereoscopic photography. So effective is the illusion of depth, that one has the impression of looking at a sculptured model; one can even appear to put one's finger behind an apparently protruding part of a picture.

The process operates with the help of ordinary photographic materials, with the addition of a grid comprising a special lenticular optical system, and the prints are apparently only slightly more expensive than orthodox first-class studio pictures. The photographs on view illustrated a variety of subjects ranging from studio-portraits to microphotographs of insects and wrist-watch movements. The applications of this new invention may be wide.

Portable Hydrogen Generator

A portable apparatus for generating hydrogen has been designed by the Meteorological Department of India. This generator makes hydrogen available at mobile observatory stations for pilot-balloon observations.

This generator uses the silicol-soda process for production of hydrogen. Charges of Ferro-silicon corresponding to the quantity of Soda are dropped at intervals of 4 to 5 minutes through a special receptacle on the top of the generator. Leakage is avoided by the use of suitable gaskets and glands, and the gas is washed in a scrubber to which the balloon to be filled is attached. This is a portable apparatus that lends itself, unlike hydrogen cylinders, to easy transport to outlying and mountainous stations.

Pilotless Flying

The United States Air Force announced that a four-engined C-54 Skymaster has completed the first trans-Atlantic flight in history without a pilot at the controls.

The transport plane took off from Stephensville, Newfoundland, at 11 p.m. (B.S.T.) on Sunday and landed at Mrisenorton, England, a distance of about 2,400 miles, ten hours fifteen minutes later.

The Skymaster was guided by a "mechanical brain", known to be the only one in existence. The mechanism involves time sequences and a radio beam.

The Skymaster was commanded by Colonel Gillin-Sill. The plane picked up a local frequency at Brisenorton, Oxfordshire, England, after which it set down its landing gear automatically and made an automatic landing. The "Pilotless" flight of the Skymaster is said to be an important step towards "push-button" warfare.

Digest of Articles on Diamonds

The Industrial Diamond Information Bureau, Industrial Distributors (1946) Ltd., St. Andrew's House, 32-34, Holborn Viaduct, London, E.C. 1,

publishes monthly a bulletin containing abstracts of articles dealing with properties and industrial applications of diamond: together with notices of patents and patent applications in many States. A copy of this bulletin may be obtained, free of charge, on application to the above address.

Gammexane for Termites

Mr. Gulvadi reports in the *Indian Forester* his trials on the successful eradication of white-ant infestations in buildings and colonies in mounds with Gammexane D 025 (powder) and LG 140 (liquid). A single application of the compound is said to be permanently effective against the insect pest.

UBESCO

In his convocation address to the Calcutta University, Sir J. C. Ghosh proposed the establishment of a United Bengal Educational, Scientific and Cultural Organisation, charged with the responsibility of maintaining the cultural unity of a divided Bengal. He felt confident that as our people began to enjoy freedom for some time, they will, no doubt, themselves proclaim that the interdependence of the various parts of India is essential for the rational solution of many problems that face the country.

New Paint Needs No Linseed Oil

A new, high-grade paint that contains no linseed oil has been developed by an English firm.

Apart from its not depending on the oil—the shortage of which has severely hampered British paint output since the end of the war—this water paint, which is called *Artoplast*, has several noteworthy features.

In the first place, it is extremely economical in use, having exceptional coverage powers. For example, an old, black wall-board can be covered with two coats of Artoplast with excellent results. Again, a ton of the paint covers half as much space again as one ton of distemper.

Artoplast is also washable, easy of application and possesses great flexibility. Exhaustive tests on canvas have shown that it neither cracks nor flakes.

The new paint is manufactured in twenty fast colours, but the manufacturers are also able to supply it in any desired shade for orders of over half-a-ton.

Andhra University

The M.Sc. degree of the Andhra University has been awarded to the following research scholars:—V. Ramakrishnamurti, T. S. G. Krishnamurti, R. V. G. Sundara Rao, P. V. Somayajulu, Bh. Krishnamurti, V. Venkateswarlu, G. Krishna Das, C. V. Suryanarayana, G. Gopalakrishna Sastri, Ch. Narasimha Rao, N. Gopalakrishnamurti, N. Venkatappayya, E. Venkayya and G. Venkateswara Rao.

Inter-National Congress on Large Dams

The Dominion of India will be one of the twenty countries of the world participating in the Third International Congress on Large Dams, which will begin on June 10, 1948, in Stockholm. The Central Board of Irrigation, Simla, is the National Committee of the Congress for India, to which intending participants from India should send their preliminary applications.

At the session of the Congress in Stockholm the National Committee will submit papers on the main questions included in the Agenda of the Congress. It will submit also other communications, which may be of interest to the members of the Congress, though not for the purpose of discussion.

It is also understood that the International Association for Hydraulic Structures Research will hold its meeting in Stockholm from June 7 to 9, 1948. And after the termination of the session of the Third International Congress on Large Dams, the meeting of the International Conference on Soil Mechanics and Foundation Engineering will take place. This will be held at Rotterdam from June 21 to 30, 1948.

Nobel Prize for Medicine

Dr. Carl F. Cori and Mrs. Cori have been jointly awarded half of the Nobel Prize for Medicine. Dr. Cori is Professor of Pharmacy and Bio-Chemistry in Washington University and his wife is an Associate Professor. The Coris have done work in research on carbohydrate metabolism and the enzymes of animal tissues. They were advised of the award by cable from Stockholm before the announcement was actually made in Stockholm, but the cable did not say which of their discoveries was the basis of the award.

Dr. Bernardo A. Houssay, physiologist of Buenos Aires, has been awarded the other half of the Prize. He has worked on internal secretions, including the thyroid glands, as well as on diabetes.

Indian Economic Conference

The forthcoming session of the Indian Economic Conference in Calcutta on December 22, 23 and 24 will be inaugurated by the Governor of West Bengal, Mr. C. Rajagopalachari.

This will be on the morning of the 22nd. It will be followed by an address of welcome by Mr. P. N. Banerjee, Vice-Chancellor of the Calcutta University, and the Presidential Address by Dr. P. S. Lokanathan

The afternoon session will be devoted to a discussion on cheap money policy. On the next two days, there will be discussions on "Commercial Policy for India" and "Problems of Agricultural Labour". A symposium is being organised by the Reception Committee on State and Nationalisation, over which Mr. N. R. Sarkar will preside.

Dr. Fred Marsden, M.Sc., Ph.D.

News has just been received of the passing of Dr. Fred Marsden, at one time Dye and Colour Expert to the Government of Madras.

Dr. Marsden was a native of Manchester (England) and studied chemistry at Owens College in the days of Sir Henry Roscoe. He graduated M.Sc. and later (1890) became a student in Heidelberg, Germany, under Victor Meyer and there attained his Ph.D.

Later he acquired extended experience in the technology of the colour industry, and during World War I was appointed Dye and Colour Expert to the Government of Madras. During that time his headquarters were transferred to the Department of Biochemistry at the Indian Institute of Science, Bangalore. There he rendered valuable help in the conduct of the Department and took part in some important researches notably on the biochemical problems of the Coir Industry.

After his retirement, Dr. and Mrs. Marsden lived happily at Budleigh Salterton, N. Devon, in their own house which was named "Hebbal" in memory of the old life at Bangalore.

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LANGUAGE MEDIUM FOR SCIENTIFIC EDUCATION IN INDIA

PROGRESSIVES in India have long been cogitating over the language medium of Education in this country. It is generally admitted on all sides that primary and popular education is most effectively and rapidly spread through one's mother-tongue, and it is a welcome sign that the provincial and State governments have commenced to implement this sound policy. As a consequence we can confidently expect the literacy and cultural level to rise with the utmost speed.

Some sentimental patriots, however, have raised a loud cry that education, both elementary and higher, must be conducted only in the provincial language. A few of the universities have, in what seems to us an undue hurry, already launched schemes of "provincialising" all branches of education. To extend this atavistic policy to all levels and all subjects of education would, we strongly feel, be extending it too far, and the move is fraught with the grave danger of putting backward the clock of Indian Science by a few generations. We have tried here to draw the attention of our scientists and statesmen to the more salient and important reasons for the indefensibility of adopting the provincial language for advanced education in science, research and allied subjects.

The linguistic survey of India enumerates 179 languages of which there are 15 major literary languages. All these have had a long history and an ancient origin. But it must be recognised that modern science has far outgrown the limited knowledge and variety of phraseology of our ancient language. In specialised branches of ever-growing scientific knowledge it would be almost impossible to find in Indian languages the right words for explaining natural phenomena. And even if we did coin them, the new terminology would be no less foreign than those to which we are now accustomed in English.

It is frequently argued that the inherent disadvantage of studying science in the vernacular could be overcome by translating the scientific books and papers. The expe-

rience of those who have tried it has shown that it is far from easy and practicable. We cite from a recent communication to the press on the subject by Sir Hari Singh Gour, Vice-Chancellor of the Saugor University.

"Thirty years ago, in 1918, the Nizam's Government established the Osmania University making Urdu the medium of instruction. When the University was started, they had no books in Urdu to help the University and, therefore, they appointed a Translation Committee which, after thirty years, has been able to translate into Urdu about 400 books through which education is imparted in the University. These books, according to this official report, contain 64,000 new words coined for the purpose; the result being that the language they have created in the name of Urdu is a different language consisting of coined words, which have to be studied in the class-rooms and which are as unintelligible to the public, as is, say, Chinese. The students who read in that University have to memorise these words for passing their examinations, but as these words are not in popular use, they have become a new language to be studied for examination purposes."

We might add that the Osmania University has succeeded in translating into 'Urdu' hardly 400 books in a period during which more than 40,000 volumes and countless number of papers have been published on advances in scientific subjects. Further, if every province had a different language medium in the field of higher scientific education and research, it would be clearly impossible to keep track of current activity in India and abroad, to exchange notes with workers in the field, to avoid duplication or to improve upon the work of others.

The Reference Committee on Scientific Terminology, appointed by the Government of India, seem to feel that a compromise is possible. The Committee has recommended that "well-known scientific terms already in use in the Indian languages with specific and unambiguous meanings and forming an integral part of the language should continue to be used, whereas for other scientific words, the international terminology should be incorporated. Such scientific terminology should deal not only with the names of objects met with in the field of science, but should also cover scientific processes. This will simplify the problem for the future when new scientific words are bound to be coined in the different parts of the world, including India". "This", the Committee feels, "does not place our students and scientists at a greater disadvantage than those in other countries in the matter of making world scientific literature easily available to them and also in making the work of the Indian scientists available to scientists abroad."

In their recommendations the Reference Committee have, no doubt, eliminated the unnecessary task of coining new scientific terms in the provincial languages; but other disadvantages persist. A graduate of one province cannot go to another Indian University for higher studies unless he masters the language of science of the new University. The difficulty does not end here. A graduate of one province cannot hope to get employment in another province or State merely on account of the language difficulty. The foregoing reasons amply prove that it will be a retrograde policy to introduce the medium of provincial language in teaching higher classes in science.

The introduction of Hindi as the medium of instruction in all the Indian Universities would be a remedy for many of the evils pointed above. But it is not the ideal. For, a student of the B.Sc. or B.Sc. (Hons.) will be expected to specialise in a large number of advanced scientific subjects for which he has to consult a good number of up-to-date scientific books and journals. As pointed out already it would be an impossible task and an utter waste of intellectual labour to try to translate every book or journal of scientific interest. It will be needless to emphasise that one would be in the dark if one has to depend upon translations into Hindi for one's research work.

The study of the advanced scientific subjects in an international language would be the ideal, and English is such a language to-day. It is the most widely spoken single language in the world. It has all the advantages necessary for an international language which the advocates of Hindi or Hindustani cannot deny. And in a world that is fast growing smaller the need for the International Language in India is at least as imperative as for a National language.

It is often pointed out by the advocates of vernacularisation that most of the advanced countries where English is not the spoken language are having their mother-tongue for the medium of instruction in advanced scientific studies, and that India could follow their example. But these enthusiasts forget the important fact that English has already become the *lingua franca* of the educated classes in India, and it is less troublesome to continue with English as

the medium of instruction for higher scientific studies than to introduce Hindi which is equally foreign to a large section of the Indian population. Why should the intelligentsia of the country waste their precious time in improving a language when they are already in possession of the best international language? It is high time that we got over irrational emotions and had a more rational and scientific outlook on the language problem.

The advantages of teaching scientific subjects in English in universities are far too many to be mentioned here. Suffice it to say that it saves the bother of translating every book of scientific interest; the scientist can be up-to-date in his knowledge since every useful scientific book or article of the world is invariably translated into English by hundreds of world-famous book companies, and a large percentage of scientific journals are published in English for the ready reference of the English-knowing scientist. Besides, typing and printing has already been standardised almost to perfection in the English language. No one can deny that Japan was as enthusiastic about her language as any other nation in the world, yet she published a large number of her scientific contributions in English and other European languages! Language is only a tool in the hands of man, and no one need be unnecessarily sentimental about it. Let us, therefore, adopt the most common language available for promoting the cause of science in India.

Coming to concrete proposals we urge that science be taught, up to the S.S.L.C. standard, in the provincial language with international nomenclature for scientific terms as proposed by the Committee of Scientific Terminology. During this period English could be taught (as Maulana Azad, the Minister for Education, has rightly directed) as a second language. After this preliminary training it is an easy step for the student to take up the study of science in the university entirely in English. This procedure, we are confident, obviates the difficulties that face the student who goes through his education either all in English or all in the vernacular. At this crucial moment in the history of our land we call upon all science institutions, conferences, congresses and academies to give serious thought to this all-important question and place their considered opinion before the universities and governments for implementation. We earnestly hope that India will not introduce in a hurry reforms for which she will have to repent at leisure.

EMPIRE JOURNAL OF EXPERIMENTAL AGRICULTURE

SIR E. JOHN RUSSELL, Chairman, Executive Committee, *Empire Journal of Experimental Agriculture*, Campfield Wood, Woodstock, Oxfordshire, U.K., has addressed a letter to Dr. J. N. Mukherjee, Director, Indian Agricultural Research Institute, New Delhi, as follows:

"I am writing to ask if you would be willing to approach agricultural research workers and officers concerned with developments to submit papers dealing with their work for publication in our Journal. We do not, of course, wish to encroach upon the publications issued by Research Stations and Departments of Agriculture. But the *Empire Journal* does provide a particularly suitable medium for publishing the results of agricultural research and developments throughout the Empire, and reaches an audience to which some of the overseas journals are not always readily accessible.

"We would welcome not only papers on specific subjects or individual pieces of research, but also summaries of results, final or in some cases interim, of long-term investigations. Although we particularly desire papers of Empire interest dealing with experiments in the field, we by no means exclude papers on other topics, such as soil problems (including soil conservation) and irrigation; meteorology, economics and education, as related to agriculture; diseases and pests of plants and animals; crop production and agricultural botany; as well as general articles on agricultural conditions and developments in particular areas."

SIR JNAN CHANDRA GHOSH, Kt., D.Sc., F.N.I.

We are glad to announce to our readers that Sir J. C. Ghosh, President of the Current Science Association, and Director of the Indian Institute of Science, Bangalore, has been appointed as Director-General of Industries and Supply to the Government of India. He took charge of his new office on the 17th of this month.

The choice of Sir J. C. Ghosh, one of the foremost men of science in this country, to this responsible position will be received with much enthusiasm and approbation throughout India. The eminence of Sir J. C. Ghosh as a leader of scientific thought and research, and his gifts at once rich and varied, were recognised both by the Governments of the country and the general public, because of his active co-operation with them in high responsible capacities too numerous to enumerate. His appointment in August 1939, as the Director of the Indian Institute of Science, Bangalore, marked the beginning of an era of rising prosperity and prestige for the Institution and also of providing an opportunity to him for developing his rich endowments for research and industrial planning. Industrial research schemes of immense importance to the development of the resources of the country and fundamental researches of high standard were initiated by him, and the income of the Institute rose steadily from about 5 lakhs of rupees in 1940 to about 18 lakhs in 1946, as a result of his prestige and influence. In recognition of his high attainments, he was Knighted in 1943 and twice invited by His Majesty's Government in England, once as a member of the Scientific Delegation to visit the U.K. and U.S.A., and second time as a representative of the Government of India to attend the Empire Scientific Conference in London.

His untiring labours and remarkable foresight were responsible in securing for the Institute, funds over a crore of rupees for opening up new departments such as Aeronautical Engineering, Chemical Engineering, Metallurgy, Internal Combustion Engineering and Power Engineering, which are the very foundations for any major industrial development of the country. The call of the nation has removed him from the Institute just at a time when his cherished dreams of scientific expansion are taking shape. His genial and unassuming temperament, his grace, nobility and charm have won for him the affection and esteem of one and all in the Institute. His ready access to students, colleagues and the public (a rare quality in people highly placed!), his benevolent kindness to all that went to him for help and guidance will be missed by all that knew him. But all these great qualities in addition to his wide range of scientific and technological knowledge and high administrative experience, are needed by the country at this critical juncture of her history. We offer him our best wishes for conspicuous success in his endeavour to serve the country.

The appointment of Sir J. C. Ghosh by the National Government is of more than ordinary significance. It is a happy sign of the resurgence of a new India fired with the earnest ambition of attaining great objectives. The time was when the Civilian was the all-purpose officer—planner, organiser and administrator of all projects. But times are changing, and so are the circumstances. It is fortunate for India that our statesmen have recognised that an all-out effort at rapid industrialization of the land requires specialists who have an intimate knowledge of the subject rather than the non-specialist politicians, however eminent. Given the scope and freedom of action, the scientist and the technical expert can, unlike the non-specialist who has to struggle through endless trials and errors, deliver the goods in the shortest possible period. We should therefore, like to believe that this appointment marks the beginning of a conscious policy of enlisting the active co-operation of experts in the field. We should, however, not rest content until ministerial responsibility in Central and Provincial Governments is directly entrusted to them in the domain of industrial, agricultural, health and scientific developments, even as law and order is entrusted to the Legal Expert and diplomatic relations to the Political Expert. It would indeed be the better fulfilment of true democratic spirit, as eminent constitutionalists have pointed out, to offer the electorate a choice from a panel of qualified experts in each branch of administration rather than call in the politician to serve in every field. Such a procedure would save some of the best brains in the country from taking to non-scientific professions owing to lack of scope for material advancement in technical and scientific professions. We have every hope that the services of a scientist, of the calibre of Sir J. C. Ghosh, will convince the Government and the public of the soundness of the policy of entrusting the planning and execution of programmes of national development to qualified experts in the respective fields.

TREND OF ZOOLOGICAL RESEARCH IN THE U. K. AND THE U.S.A.

K. N. BAHL

(*The University, Lucknow*)

DURING the last twenty-five to thirty years there has been a complete transfer of interest in Biology, both in the U.K. and in the U.S.A., from the earlier predominantly morphological standpoints to the more analytical experimental methods. During the last century when the fauna of most countries was not adequately surveyed, taxonomy and comparative anatomy attracted a large number of workers but now-a-days taxonomic work is confined only to workers in museums, and the discovery of a new species or a genus is considered a very minor event in Biology. Till the earlier years of this century comparative anatomy, embryography and phylogeny occupied the stage, so to speak, and the triumph of the doctrine of Evolution has owed much to the study of the structure and development of animals. Subjects like metamerism, segmentation of the vertebrate head, the morphological interpretation of the cranial nerves, *Limulus* and the ancestry of the vertebrates, origin of land vertebrates, adaptive radiation in the Reptiles, cell-lineage and the determinative type of cleavage were some of the hghlights of morphological research. In spite of these notable advances Zoology remained almost wholly a descriptive science little concerned with the active processes of life. Although zoologists still have a high regard for the basic discipline of comparative anatomy, they have now realized that the method of comparative anatomy must increasingly embrace considerations of function: it is not enough to examine diverse animal forms, the significance of their diversity must also be properly appraised. In modern biological research, therefore, there is a growing reliance on the more exact techniques of physics, chemistry and even mathematics, so that experimental biology in its various aspects has now developed into many newer disciplines like general physiology, biochemistry, biophysics, genetics, experimental embryology and ecology. The purely vitalistic conceptions of earlier days as working hypotheses have largely given place to mechanistic conceptions of the processes of life—in fact for the proper understanding of the working of the animal machine, the working hypothesis of a modern biological research worker can only be the mechanistic view of life, however inadequate it may be in the present state of our knowledge.

This change of interest from morphology to physiology began on the European continent, and thence spread both to the U.S.A. and the U.K. In the U.S.A. the Woods Hole Marine Biological Laboratory has developed into a fine and important institution: it is not only a meeting and working place in summer for biologists from all over the country but serves as an important clearing house both of biological research and biologists—it combines the advantages of a large scientific society in residence and a truly democratic social club. There are about 400 workers and their families in residence in summer taking advantage of the excellently equipped laboratory and a very well stocked scientific library. Here, as early as 1891, Whitman advocated the development of "biological physiology" as distinguished from mammalian physiology of the medical schools. He emphasised that "the association of morphological and physiological research enlarges the field of vision on both sides—converts half-views into whole views." Whitman's own work was largely morphological—his classical monograph on the "metamerism of *Clepsine*" is still a masterpiece—but he invited Jacques Loeb to lead the Department of General Physiology both for instruction and research. This laboratory continues to offer a very efficiently run course in general physiology—probably the best in the world. Jacques Loeb and his co-workers made Woods Hole the centre of general physiology and its influence spread throughout the country. Embryology has always been a favourite subject at Woods Hole, as in summer it is a veritable paradise for students of development because of the wealth of material available for study. Jacques Loeb and his collaborators made full use of these opportunities and gave an experimental turn to embryology as well. Loeb's experiments on the production of multiple embryos and his famous discovery of artificial parthenogenesis, Wilson's experimental analysis of cell-lineage in the eggs of *Dentalium* and *Patella*, Conklin's work on the ascidian egg and the "organ-forming substances", Lyon's suggestion of the use of centrifuge in experimental embryology, and Morgan and Lillie's demonstration of polarity and bilaterality of the egg are some of the well-known results of experimental embryology of the earlier days at Woods Hole. Jacques Loeb also gave an impetus to the study of regeneration and regulation and wrote a book *Regeneration from a Physico-Chemical View-point*, just before his death. T. H. Morghan of *Drosophila* fame worked for several years on the experimental analysis of regeneration, and C. M. Child furnished the ideas of axial gradients and physiological isolation. The mystery of fertilization was explained by the analytical and experimental work of Wilson, Mathews, Conklin and Lillie. Mead and Morgan carried the analysis a stage further till Loeb put the coping stone, so to speak, by his work on artificial parthenogenesis. In cytological studies the work of Wilson, Montgomery, Morgan and Muller is too well known to be repeated here. Wilson was the first to present the theory of sex-chromosomes: Morgan by his epoch-making work on *Drosophila* established a clear relation between cytology and genetics, while Muller of Indiana used X-rays on the genes to produce mutations.

During recent years Parker's work on the elementary nervous system, the micro-dissection apparatus of Robert Chambers and its use in the study of cellular physiology, Paul Weiss's work in experimental embryology and his demonstration of the distinction between *auto-*

nomous versus *reflexogenous* activity of the central nervous system, Heilbrunn's work on the colloid chemistry of protoplasm, Harvey's work on animal light, Brooks's work on the permeability of the cell-membrane, Willier's work on transplantation in chick embryos, and Uachmansohn, Welsh, Prosser and Bullock's work on the physiology of the nervous system are worth mentioning.

In U.K. this change of interest is markedly reflected in the universities and other research institutes. At Cambridge almost all the zoologists are experimental zoologists, and the older people with a morphological bias complain that there is no morphologist left, although morphology is the bed-rock of zoology. Even at other British universities the bulk of zoological work carried on now is experimental. The Society for Experimental Biology, founded in the early twenties is a very active body; it holds conferences three times a year and publishes the *Journal of Experimental Biology* every quarter. The famous Oxford morphological journal, the *Quarterly Journal of Microscopical Science*, edited by Lankester and Goodrich, both leading morphologists of their times, for over 75 years, has recently changed its original morphological character and is now publishing memoirs on Functional Morphology, Cellular Biology and Histo-Chemistry. On looking through the pages of *Proceedings of the Royal Society* (B), one cannot fail to discern that most biologists in U.K. are now physiologically minded. How much of importance is given to experimental zoology will be gauged from the fact that recently John Z. Young of Oxford, whose brilliant work on nerves is well known, has been appointed Professor of Anatomy at the University College London, even though he has had no formal medical education and had possibly never dissected the human body. It has been realized that classical anatomy has long since exhausted itself, and we need a new generation of anatomists like Young in whose hands morphology correlated with parallel biochemical and biophysical analyses with considerations of function will result in profitable advances in anatomy.

Great advances have been made in several directions during the last quarter of a century, and it is difficult even to catalogue them; but perhaps the best example of recent experimental trend in Zoology in U.K. and U.S.A. is the important advance in our knowledge and understanding of the nature of the nerve-substance and its conduction activities. Not many years ago (1934) John Z. Young discovered giant nerve-fibres, about 1 mm. in diameter, in the squid *Loligo*: these giant nerve-fibres have proved excellent material for a study of the structure and conduction activities of the nerve-fibres, about which we now have perhaps more information than about any other bodily function. They have not only allowed direct confirmation of previous deductions but have also made possible the investigation of many new aspects of the process. These nerve fibres have been studied with the help of various optical and other physical and chemical techniques as well as by histochemical methods and by the use of the Electron microscope.

It has long been known that when a nerve-message travels along a nerve fibre, the active region becomes electrically negative to all the neighbouring regions. In the resting condition there is a potential difference the resting potential between the inside and outside of the nerve-fibre: it has now been shown that potassium is present in much greater quantities (26-29 times) inside than outside, while sodium and chlorine are present in smaller amounts within the fibres than around them. During the passage of the nerve-impulse, the nerve membrane becomes freely permeable to all ions and an electric wave the action current flows between the active and neighbouring regions, and during this process, potassium leaks out of the nerve-fibres. The effect is compared to that of a membrane with selective permeability separating two electrolytes. Optical investigations of the nerve-fibre in ordinary and polarised light have shown the presence of longitudinal organization in the molecules composing the nerve-fibre.

The conduction velocity of the nerve-impulse is increased by (1) increasing the diameter of the nerve-fibres and thus reducing internal resistance and (2) by changing the characteristics of the membrane. The second method has been adopted in the vertebrates where each nerve fibre has a "myelin sheath", while the squid has adopted the first method of increasing the diameter of its nerve fibres. The conduction rate in the large fibres of the squid is about 25 metres per second the same is the rate in the giant fibres of the earthworm which have a fatty sheath around them. In birds and mammals with a constant high temperature the speed may come to more than 100 metres per second. In mammals each nerve contains a spectrum of fibres of different diameters (in rabbit they vary from 1·8 to 18 μ) and conduction rates; the fastest fibres with a diameter of 18 μ (including a sheath of 5 μ) are those that go to muscles, the messages concerned with touch are carried at 25 metres per second, while fibres concerned with pain conduct only at 1 metre per second.

It has been found that when a nerve is severed, the nerve fibres of the peripheral part disappear leaving only the framework of the nerve composed of connective tissues and other elements, while the nerve fibres of the central stump remain in tact and put out new growths. Since each large nerve contains thousands of nerve fibres with different diameters as well as conduction rates and functional connexions, it is necessary for proper regeneration that appropriate connexions must take place between the central and peripheral stumps. Motor nerve fibres must join up with muscles and not with skin and so on. It has been found, however, that connexions are unfortunately made at random. Many wrong and some right connexions are made, and it is not surprising, therefore, that after severance of a nerve, the return of function is never completely satisfactory. There is poor co-ordination of muscle-movements and there are abnormal pains and unpleasant sensations. It is possible that there is some mechanism by which the incorrectly connected fibres are later removed, but this mechanism has not yet been demonstrated.

The problem of the conduction of nerve impulses has been attacked from the chemical side as well, and this work carried out during the last 25 years forms a most fascinating story. In 1921 Otto Loewi proved by a simple experiment that the nervous impulse in the vagus nerve of a frog does not influence the heart-muscle directly, but through a chemical substance liberated from its nerve endings. Lowi called this chemical transmitter the *vagusstoff*, which was later identified as *acetylcholine* by Dale and Dudley in 1929 this substance produces decrease of both frequency and amplitude of heart-beat. Another substance *adrenaline* is released by the cardio-accelerator nerves, and this brings about an increase both of frequency and amplitude of the heart-beat. In all cases studied, it has been proved that the mode of transmission of impulses from the postganglionic autonomic nerves to their respective effector organs occurs through the release of a chemical transmitter. We have already seen that there is a shifting of ions, specially of potassium, during the propagation of an impulse in the nerve; it has now been demonstrated that it is the liberation of potassium that is responsible for the liberation of the chemical transmitter acetylcholine. After the impulse has passed, the released acetylcholine is split up and rendered ineffective by a hydrolyzing enzyme, *Cholinesterase*; and it is thus that in many instances the effect starts and stops almost simultaneously with the stimulation. Nachmansohn has demonstrated that acetylcholine can be synthesised in the nervous tissue through another enzyme called *cholinacetylase*. The neuro-chemical mechanism of the transmission of nervous impulses is now believed to apply to all the synapses of the autonomic system and to the spinal nerves. With the discovery of the giant-fibres, it has been possible not only to make analyses of potassium, but also of nerve-proteins in the axoplasm. The only gap in our knowledge is the definite proof that the chemical transmission from one neuron to the next holds true also in the C.N.S. (central nervous system). It is known that acetylcholine is able to augment or to inhibit activities going on in the C.N.S. and to initiate activities there exactly as it does in the peripheral elements. This taken together with the distribution of the cholinesterase and acetylcholine makes it possible to say that the latter acts as a transmitter in the C.N.S., just as it does in the peripheral nervous system. But the question whether or not acetylcholine is *the* synaptic transmitter within the C.N.S. as in the peripheral nerves has not yet been definitely solved.

This knowledge of the nervous system has been gradually built up by a host of workers by using various kinds of techniques. In modern Biology more than half the battle is the perfection of techniques of various kinds. For example, locomotion in animals has been studied with the help of cinematographic photographs; bat "radar", by the use of microphones; nerve-conduction with the cathode-ray oscillographs; osmotic regulation and water-balances by measuring osmotic pressures and vapour pressures, chemical estimations of various ions and so on, while the animal form and the processes of growth have been studied mathematically.

In India physiology is unfortunately still linked with medical schools—it has not developed into general, cellular and comparative physiology, biochemistry and biophysics in the modern sense. Our teaching still deals only with the descriptive aspects, and the experimental disciplines are very inadequately reflected in our zoological teaching and research. The British Delegation to the 34th Indian Science Congress (1947) particularly noted this fact, and their leader, Sir Charles Darwin (*Nature*, March, 13, 1947) has rightly remarked that "in the biological sciences the emphasis has been more on the systematic and taxonomic side than on the physiological". It is time we in India took to the newer disciplines in Zoology so that our teaching and research are modernised and are beyond reproach. With the advent of political independence we must improve our teaching and research equipment and reach the highest standards possible so as to keep abreast of research activities in the West.

AN APPEAL

THE Department of Industrial Chemistry started working in July 1921 on a modest scale. Of all the Indian Universities, the Benares Hindu University was the first to start a specialised course in Industrial Chemistry at the post-Inter-Science stage. During these twenty-five years, specialised courses in Pottery and Porcelain, Glass, Metal Enamelling and Pharmacy have been started, and since December 1939 a full-fledged College of Technology has been functioning. In these twenty-five years, nearly a thousand and five hundred students have passed through the portals of this College. On this auspicious occasion of the Jubilee Celebration of this Institution, Dr. N. N. Godbole, Principal of the College, has rightly conceived the idea of establishing a "first class Technological Library" worth a few lakhs of rupees which will undoubtedly form a very valuable asset to the successful working of the College of Technology. We endorse warmly the appeal issued by Dr. Godbole, and we are hopeful that the Princes and the public, specially the Industrial Magnates of India who have contributed to the building up of the University, will also help in establishing a first-class Library for the College of Technology of the Benares Hindu University.

M. M. MALAVIYA.
S. RADHAKRISHNAN.

[We are confident that the readers of *Current Science* will respond generously to this appeal. —ED.]

THE NUCLEUS AND NUCLEIC ACIDS*

THE nucleic acids are said to function as the "molecular midwife of all reproductive particles". In his paper on the "Nucleic Acid and Chromosomes" Dr. Darlington proceeds on the assumption that while nucleic acids play a major role in the formation of the chromosomes, the chromosomes in turn are responsible for the production of nucleic acids. The question naturally arises whether nucleic acids enter into the composition of the chromosomes. Stedman and Stedman, in a contribution entitled, "The Function of Desoxyribose-Nucleic Acid in the Cell Nucleus" dispute the above assumption, and, proceeding on the basis that the chromosomes and the nuclear sap are the two important constituents in the dividing nucleus, suggest that while histone nucleate forms the matrix of the cell nuclei, the acidic protein, chromosomin isolated by them from nuclei, forms the main constituent of the chromosomes. The chromosomin is said to be dispersed in the matrix or enclosed in the nucleoli of resting nuclei, and that during division it concentrates to give rise to the chromosomes. The histone nucleate, on the other hand, is said to form the spindle since they believe that the physico-chemical properties of nucleic acid are ideally suited for that purpose. It is not, I believe, disputed that there is a permanent chromosome fibre. It has been assumed by the majority that during mitosis, "desoxyribose nucleic acid is attached at specific loci to the polypeptide chain which represents the permanent chromosome fibre" (Koller, p. 270). Nobody in fact seems to have questioned the possible occurrence of chromosomin in the chromosome fibre. On the other hand, Stedman and Stedman veer to the other extreme. While granting that the chromosomin threads, constituting the chromosomes, would be embedded in the matrix of the nucleus and hence should naturally be in contact with the nucleic acid with the probability of a chemical combination between them, they brush aside the idea that such combined nucleic acid could ever be considered as a component of the chromosomes. The nucleic acid is considered merely to increase the basophily of the chromosomin by increasing its acidic properties. Unlike the metaphase chromosomes, the salivary chromosomes of Drosophila do not show a uniform staining. Only the bands are basophilic. Stedman and Stedman, in trying to reinterpret Caspersson's observations, offer the novel suggestion that the swollen condition of the chromosomin in the interband regions is the real cause for their reduced basophily. That the differential staining cannot be explained away in such a simple fashion is emphasized by Danielli in his contribution, "A Study of Techniques for the Cytochemical Demonstration of Nucleic Acids and some Components of Proteins". Investigations show that while the interband regions are deficient not only in purines and pyrimidines but also in tyrosine, tryptophane and histidine, the above occur in considerable quantities in the bands. "It, therefore, follows that the interbands cannot consist of typical histones, nor of the chromosomin of the Stedmans, unless these proteins consist of very long polypeptide chains, lengths of which of the order of μ are deficient in histidine, tryptophane and tyrosine, whilst other lengths of similar dimensions are rich in these substances" (p. 112).

Generalizations are often fraught with danger; and, since Stedman and Stedman seem to place more emphasis on their experiments with sperms, an experience recorded by Brachet in his contribution, "Nucleic Acids in the Cell and Embryo", may be appropriate. In the case of some spermatozoa and red blood cells, thymonucleodepolymerase had no effect on their basophily at all. The nuclei of such cells, however, gave a positive Feulgen reaction; and microchemical estimations confirmed that the nuclei are rich in thymonucleic acid. Brachet rightly observes that "the correct conclusion is that thymonucleic acid is not attacked by thymonucleodepolymerase in these nuclei; this is an interesting fact in itself, which deserves further studies on the nature of the thymonucleic acid present in these cells and on the links uniting this acid to the proteins" (p. 209). A balanced view would appear to be that as the greater part of purines and pyrimidines are present in the bands and as Feulgen's technique shows that the desoxy sugar is associated with the chromosomes, the sugar is most likely to be in the bands in combination with purines and pyrimidines.

It would be seen that whatever be the role played by the nucleic acids in the actual structure of the chromosomes, they do play an important role in cell division and metabolism. Dr. Gulland suggests in his paper on the "Structure of the Nucleic Acids" that the nucleotides have only a random arrangement in the polynucleotides. Structure and synthesis of Nucleotides are dealt with by Lythgoe and Todd, and Biological Synthesis of Purines by Kalckar. Astbury, from his "X-Ray Studies of Nucleic Acids", draws attention to the fact "that the spacing (3·34 A) of the nucleotides along the thymonucleic acid column is to all intents and purposes the same as the distance from one side chain to the next along an extended polypeptide, and even at the risk of being accused of dabbling in numerology, I should like to say again that I believe this to be no mere coincidence ... Bio-synthesis is supremely a question of fitting molecules or parts of molecules one against another, and one of the great biological developments of our time is the realization that probably the most fundamental interaction of all is that between the proteins and the nucleic acids" (p. 70). Davidson deals with "Distribution of Nucleic Acids in Tissues" and Stacey with "Bacterial Nucleic Acids and Nucleoproteins". The staining of the vacuoles in living cells is analysed by Dustin who suggests that presence of small quantities of ribonucleoproteins may be the cause of vital staining.

* "Nucleic Acid" Symposia of the Society for Experimental Biology, Number One. Cambridge University Press, 1947. Price 30 *sh.*

Quantitative Cytochemistry using ultra-violet light and a Quartz Microscope is elaborately discussed by Prof. Caspersson. "All results show that the ribose nucleotides belong to the regular cell constituents. The ribose nucleotides were found in fact, to be one of the most common of all cell constituents, and in 1939-40 evidance accumulated from *different lines of studies that they were connected with the synthesis of the cytoplasmic proteins*" (p. 136). The Nerve Cell does not appear to be an exception to the general rule. Hyden presents evidence that extensive quantitative changes in nucleotide and protein contents of nerve cells are associated with motor and sensory functions. Changes in neurons, morphological, physiological and chemical, during regeneration are shown by Bodian to be "in the direction of reversion toward the levels of embryonic period, with subsequent return to adult levels as regeneration is completed" (p. 175). Experiments with pentose nucleotides are discussed by Parsons, Gulland and Barker who were able to "reproduce with singular exactness the systemic effects induced in mice by X-radiation, by treatment with carcinogenic compounds, or by the growth of a primary or grafted sarcoma" (p. 189). The role of ribonucleic acids in metabolism and the phenomena of induction during development is discussed by Brachet who emphasizes that "both during normal induction and evocation, there is a marked synthesis of ribonucleic acid in the reacting ectoderm; one of the consequences of induction is, therefore, a local synthesis of ribonucleic acid which might well lead in its turn to the production of specific organ-building proteins" (p. 221).

There are very interesting contributions by Stowell on "Histochemical Observations on Nucleic Acids in Homologous and Neoplastic Tissues", by Catcheside and Holmes on the "Action of Enzymes on Chromosomes" and by Koller on "Experimental Modification of Nucleic Acid Systems in the Cell".

The diverse trends of investigations on Nucleic Acids are admirably presented by the different contributors making available to those interested a mine of information. An attempt is made to establish closer links between biochemistry, cytology, embryology and genetics, and the volume hence deserves the attention of students of the different disciplines. It ought to find a place in every library.

M. K. SUBRAMANIAM.

THE TRAINING OF PLANT PATHOLOGISTS IN INDIA

S. V. VENKATARAYAN

(Department of Agriculture in Mysore, Bangalore)

PLANT pathology comprises a study of all diseases of plants,. whether caused by fungi, bacteria, viruses, physiological disturbances, or by insects and other animal pests. In the U.S.A., however, plant pathology does not include diseases caused by insects and higher animals. The training of plant pathologists in India consists of taking a degree in Botany or Zoology, or a diploma or degree course in Agriculture at one of the Universities. There is also the two-year post-graduate course at the Indian Agricultural Research Institute at New Delhi for the advanced worker. While this course is the best training available, the following remarks apply only to the training in Natural Science and Agriculture available in the Universities. The views expressed are with particular reference to the Botany and Mycology teaching, but the position with regard to Zoology and Entomology is not far different.

These remarks were prompted by the report prepared by the Plant Pests and Diseases Committee of the Council of the Association of Applied Biologists entitled "The recruitment and training of plant pathologists in Great Britain",[1]

The report deals with four classes of officers: (1) the County Officers, (2) Specialist Advisers, (3) Research Workers and (4) Technical Assistants. The Specialist Advisers and Research Workers are men with two-year post-graduate training after a degree in Pure Science, and hence they are beyond the scope of this note. The technical assistants do work of a routine nature as assistants to research workers and others, and are drawn from various sources and trained in some particular branch by their seniors. Sometimes these may also eventually engage in research or other work of their own. They require all encouragement but their number will always be very small. There are then left only the County Officers (corresponding to our Agricultural Inspectors or Demonstrators and the junior technical staff), who are usually persons who have obtained a degree or a diloma in agriculture or horticulture, at an Agricultural or Horticultural College. The course for these officers is "of a general nature, and plant pathology being one of many subjects in a heavy syllabus, is often dealt with only briefly". The training facilities at present at many Universities and Agricultural and Horticultural Colleges in Great Britain are such that "certain of the Pure Science courses give little training in field studies, and many of the Agricultural and Horticultural courses devote very little time to certain aspects of Pure Science."

Comparing the position in Great Britain with that in the U.S. of America, the report says, "this situation compares unfavourably with the position in the United States where the facilities for the teaching of plant pathology in some Universities are on a very extensive scale. The accommodation and equipment for the study of the subject are considerably better than those of any British University. In the U.S.A., besides the Federal and various state Governments, private benefactors have contributed large sums of money for training and research of scientific workers, as evidenced by the

grants from the Carnegie Institution of Washington, The Boyce-Thompson Institute for Plant Research, New York, and the Rockefeller Institute for Medical Research, Princeton, New Jersey, which is also financing research on the virus diseases of plants.

In India the study of Botany and Zoology in the schools and colleges was a late introduction, and quite naturally the attention paid to mycology, bacteriology and entomology is very limited. The second meeting of mycological workers of the Board of Agriculture in India held at Pusa in February 1919, passed the following resolution: "That this meeting desires to call attention to the neglect of mycological science in Indian Universities, and wishes to emphasize the importance of the subject in India, and to urge on the Universities to give courses and found lectureships or chairs in the subject." During the course of the discussion the late Dr. F. J. F. Shaw observed that even students taking the M.Sc. degree were totally ignorant of the fungi of their own country, although they could answer complicated questions on European fungi and plant diseases, and he said that some Indian Universities appeared even to resent any questions in their examinations on Indian mycology. The position to-day, after the lapse of nearly thirty years, is only slightly better. The curriculum in Mycology is not much improved, and the number of students offering mycology for the M.Sc., or M.Sc. Ag., is limited. The course in the Agricultural Colleges is slightly better, but still not of the standard to make the student an efficient plant pathologist. Until adequate facilities are available for a post-graduate course in the subjects the position will remain the same.

Regarding the recommendations for the future, the Plant Pests and Diseases Committee of Great Britain suggest the formation of a new Plant Pathology Training Centre or Centres, or in the alternative, the strengthening of certain existing University Departments of Botany and Zoology to allow of post-graduate training in plant pathology. The Centres should be out in the country where different types of crops could be grown, and liaison established with farmers, and not too far from towns so as to ensure attendance at meetings of scientific societies. In addition to class work it is recommended that there should be fully-equipped mycological and entomological laboratories where the students will receive a thorough training in laboratory technique to be supplemented by training and research in the field. The students should be trained in the methods of observation of disease in growing plants, in methods of plant protection and in the technique of field experimentation. In addition to this there must be an active research section where researches on plant diseases and pests is being carried out by senior research workers. The training and maintenance of students should be covered by adequate financial provisions, the number of scholarships being related to the estimated demand for the workers, and the scholars assured that on satisfactory completion of the training suitable positions will be offered to them.

The Indian Council of Agricultural Research has, as one of its aims, the granting of research scholarships and provision of post-graduate training, but since it can only utilize the existing facilities, and since the translation of agricultural improvements into practice is the function of Provincial Governments and States, not much headway can be made in this direction. It is to be hoped that the measures of income-tax and super-tax relief in the case of endowments for scientific research contemplated by the erstwhile Finance Member of the Government of India, Sir Archibald Rowlands, will start a stream of generous contributions for a National Institute of study and research in the various plant sciences in India.

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1. *Applied Biol.*, 1946, **33**, 119.

EARTH'S MAGNETIC FIELD

INVESTIGATIONS of the mysterious changes in the magnetic pull of the earth experienced by aircraft flying over British Empire routes have been undertaken by a team of experts from the Empire Air Navigation School, Shropshire.

Research by the school into the earth's magnetic field has already yielded valuable scientific results. The flight of "Aries One" over the North Pole two years ago resulted in confirmation of calculations of the location of the magnetic field pole and gave practical experience of the behaviour of the magnetic compass when flying over these regions.

The changes in deviation now to be investigated were first noted when "Aries Two" flew to South Africa last April at the same time as the Transport Command Mosquito which broke the record to the Cape. Both aircraft experienced unexpected changes in deviation, sometimes as much as ten degrees, although these were found to have disappeared when the compasses were checked on their return home.

The equipment used for this new investigation included twelve magnetic compasses, and aircraft magnetometer, for measuring the strength of the earth's magnetic field, and a new type of electric compass which does not depend on a magnet for direction, but which incorporates an electronic control.

The route flown covered Malta, Habbaniya (Iraq), Negombo (Ceylon), Singapore and Darwin (Australia) outward; and Singapore, Negombo, Nairobi, Cape Town, Heany (Southern Rhodesia) and Khartoum homeward. Possible explanations arising from these investigations are awaited with interest.

LETTERS TO THE EDITOR

PAGE

ON THEORY OF A NEW METHOD FOR DETERMINING YOUNG'S MODULUS

ALL the available methods for determination of the Young's modulus involve mechanical means for producing the strain. It is, however, well known that strains can be produced in the conducting material by electro-magnetic methods; but no use is made of the foregoing fact for designing a method leading to the determination of Y. The object of the present note is to give the theory of a possible simple method based on the above principle.

Let the conducting material, in the form of an anchor-ring, have a mean radius, r—large compared with the cross-sectional radius. Let it be traversed by a strong direct electric current i. On placing the ring in the field H of a powerful electro-magnet with its plane perpendicular to the field, the radius r will undergo a change by δr, the measurement of which finally leads to the value of Y for the ring.

Each line element ds of the ring is acted upon by a force of value '$Hids$' in the plane of the ring tending to increase or diminish the area of the loop depending on the direction of the current. Thus in the material of the ring a state of tension is set up, the value of which is given by,

$T = Hir$ ..... (1) as obtained by considering the equilibrium of the element ds. If A is the cross-sectional area of the ring then $\frac{T}{A}$ denotes the stress, and $\frac{\delta r}{r}$ the strain. Thus using (1) we get the value of Young's modulus

$$Y = \frac{Hir^2}{A\delta r} \qquad (2)$$

That the method is quite workable can be seen from what follows. Let us choose an arbitrary specimen, say a ring of copper wire, having $r = 1$ cm.; and $A = \cdot 002$ cm.^{2} (S.W.G. No. 25). For a moderate current and a field of about 10,000 Gausses which can be readily applied in a laboratory the δr will be of the order of about ½ μ. This value of δr is quite within the range of interferometric methods of measuring small distances.

Department of Physics,
Dungar College,
Bikaner,
July 22, 1947.

V. L. TALEKAR.

NEW METHODS OF OBTAINING SQUARES OF NUMBERS

MR. A. A. SIDDIQI under the above heading has published two notes[1,2] in your esteemed Journal, with a view to giving new, simple and ready methods for calculating the squares of numbers. He has done also some examples to illus-

trate both of his methods. I take liberty to give in this respect the general formulæ from which his methods follow as direct statements.

Below are the general formulæ; for the first method:—

$$\left(\sum_{1}^{n} 10^{r-1}\cdot a_r\right)^2 = \sum_{1}^{n}(10^{r-1}\cdot a_r)^2 + 2\Sigma 10^{p+q-2}\cdot a_p\cdot a_q \quad (1)$$

$p \neq q$, where a_r denotes the figure in the rth place in the number of n digits. And for the second method:—

$$\left(\sum_{1}^{n} 10^{r-1}\cdot a_r\right)^2 = b^2 + 2\cdot 10^{n}\cdot \sum_{1}^{n} 10^{r-1}\cdot a_r - 10^{2n} \quad (2)$$

where $10^{n} - \sum_{1}^{n} 10^{r-1}\cdot a_r = b$.

Moreover it is to be noted that the second method is valid for all cases where the given number,

$$\sum_{1}^{n} 10^{r-1}\cdot a_r > b,$$

and not particularly when a majority of figures in the given number are greater than 5, as mentioned by him in his latter note.

Department of Physics,
Dungar College,
Bikaner, V. L. Talekar.
September 12, 1947.

1. Siddiqi, *Curr. Sci.*, 1947, **16**, 178. 2. —, *Ibid.*, p. 251.

A NOTE ON THE OCCURRENCE OF SPORES COMPARABLE TO *RODEITES DAKSHINI* SAHNI FROM THE DECCAN INTERTRAPPEAN BEDS OF VIKARABAD

The purpose of the present note is to record the occurrence of spores, comparable to those of *Rodeites dakshini* Sahni from the intertrappeans of Vikarabad area in Hyderabad State and to throw light on the age of the intertrappean beds of this area.

There are one complete and one half of two circular sections about 380 μ in diameter. The spore wall consists of four layers. There are two inner layers which can be distinguished under high magnification, then there is a prismatic layer, with the cell walls radially elongated. This is the thickest portion of the spore wall, about 35 μ. The cells must have been tabular or prismatic. The outermost part is one-layered and thick. The spore wall is in all about 45 μ thick.

The entire section is circular in outline. The other section is semi-circular. It lies on the edge of the microslide. These two seem to exhibit the typical wall structure of the sporocarp of the Marsileaceæ.

The megaspores of all the genera, *Marsilea*, *Regnellidium* and *Pilularia* are almost identical in a transverse section. The dehiscence of the spore and the nature of the resulting apical papilla are of classificatory importance. No signs of dehiscence were seen in the available sections. This might be due to one or both of two reasons, *viz.*, either the sections might not be in the median longitudinal plane, or the spores might not have dehisced at all.

A fossil sporocarp, containing both mega- and micro-spores, comparable to that of *Regnellidium diphyllum* has been described under the name *Rodeites dakshini* by Sahni.[1] The spores of the same genus were described by Sahni and Rao.[2]

Rodeites dakshini is from the intertrappean beds of the Central Provinces. The horizon being simliar, there is great possibility for these being identical, but pending definite evidence such a comparison is not made.

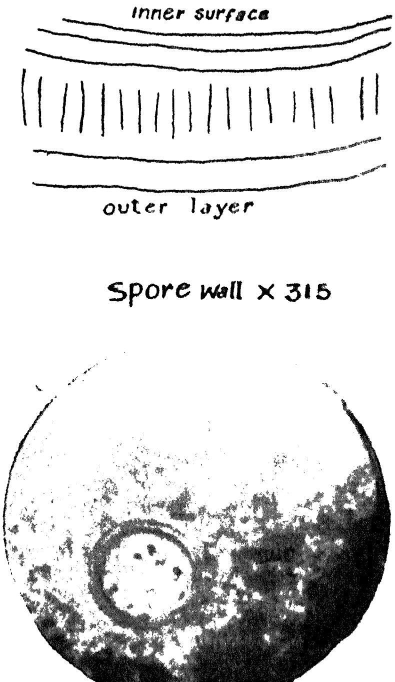

Figure and Photograph showing one complete and one half of two sections of the Spores. (× 30)

Seward[3] has remarked that the Hydropteridinæ are almost completely absent from pre-Tertiary strata. This suggests that beds containing them are not older than Tertiary in age.

The author's thanks are due to Prof. C. Mahadevan for his help and guidance, and to Mr. Syed Kazim, Director of Mines and Geological Survey, Hyderabad (Dn.), for permission to work on the materials.

Andhra University,
Waltair, S. R. Sarma.
August 11, 1947.

1. Sahni, B., *J. Ind. Bot. Soc.*, 1943, **22**. 2. Sahni, B. and Rao, H. S., *Proc. Nat. Acad. Sci. India*, 1943, **13**. 3. Seward, A. C., 1910, *Fossil Plants*, **2**.

CHEMICAL COMPOSITION OF STORAGE ORGANS OF PLANTS—A FACTOR IN PHOTOPERIODISM

Several investigations by the author have shown that the chemical composition of the storage material of plants markedly affects their physiological behaviour with regard to several functions.

It has been observed that those plants in which starch is the main storage material continue to flower at a higher temperature than those in which sugar is mainly stored. Experiments on beet (*Beta vulgaris*) and barley (*Secale cereale*) gave the following results (Table I). The data are based on observations of a minimum of ten plants in all treatments

TABLE I

Effect of Various Temperatures and Photo-periods on the Initiation of Flower Primordia in Beet and Barley

Temperature	50–55° F.		60–65° F.		70–75° F.	
Photo period	10 hrs.	15 hrs.	10 hrs.	15 hrs.	10 hrs.	15 hrs
Beet ..	Flowered	Flowered	Vegetative stage	Vegetative stage	Vegetative stage	Vegetative stage
Barley ..	Flowered	Flowered	Flowered	Vegetative stage	Vegetative stage	Vegetative stage

It is evident from Table I that in beet, in which sugars are mainly stored, plants flowered only at 50°–55° F., higher temperatures resulting in vegetative growth only. In barley, on the other hand, flowering took place even at 60°–65° F., but only in a 10-hour photoperiod, longer photoperiods and higher temperatures resulting in vegetative growth only. The reversible reaction:

Starch ⇆ sucrose ⇆ reducing sugars is greatly influenced by temperature. A lowering of temperatures favours the formation of sugars, and a rise in temperature results in the formation of starch at the expense of the sugars.

The detailed paper will be published elsewhere.

College of Agriculture, P. B. MATHUR.
Benares Hindu University,
August 22, 1947.

HEAT CONDUCTIVITY AND MOLECULAR COMPLEXITY OF WATER

THE author has shown previously[1,2] that the *positive* temperature coefficient of the heat conductivity of water can be accounted for by the dissociation of the complexes present in the liquid.

Jacob[3] measured the heat conductivity, K, of water at various temperatures t between 7°·4 C. and 72°·6 C. Table I contains values of K for the liquid at different temperatures, read off from Jakob's plot of K against t; the association factors n are due to Ramsay and Shields[4] corrected by Macleod.[5] In Fig. 1, K is plotted against the corresponding n. It will be

TABLE I

t (°C.)	K	n
10	0·00136	3·86
20	0·00141	3·60
30	0·001455	3·40
40	0·001493	3·24
50	0·001527	3·12
60	0·001563	3·01
70	0·001589	2·90

seen that *Ceteris paribus*, the heat conductivity of water, is sensibly a linear function of its degree of association. The fact that so simple a relationship should appear, between the two

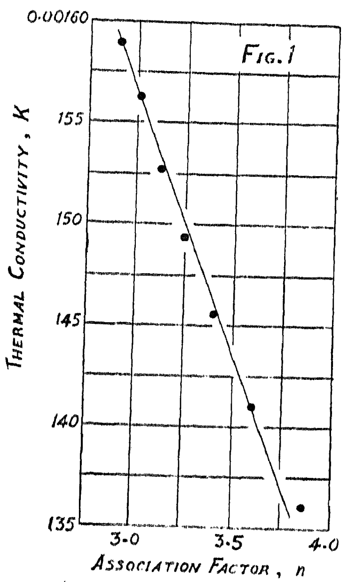

FIG. 1

otherwise unrelated phenomena, lends support to the author's view regarding the *positive* temperature coefficient of water.

Chemistry Department, S. R. MOHANTY.
Benares Hindu University,
September 5, 1947.

1. Mohanty, S. R., *Proc. Ind. Sci. Cong.*, 1947, **3**, *Phys. Sec.*, 26. 2. —, *Curr. Sci.*, 1947 **16**, 55. 3. Jakob, M., *Ann. der Phys.*, 1920, **63**, 537. 4. Ramsay W., and Shields, J., *J. Chem. Soc.*, 1893, **63**, 1089 5. Macleod, D. B., *Trans. Faraday Soc.*, 1925, **21**, 145.

PRODUCTION OF VITAMINS OF THE B-GROUP BY *B. SUBTILIS* GROWN ON SYNTHETIC MEDIUM

IN the preparation of bacterial amylases, the enzyme is usually precipitated by either progressive salt saturation or addition of miscible organic solvents. When alcohol is used for precipitation, it has been found that the

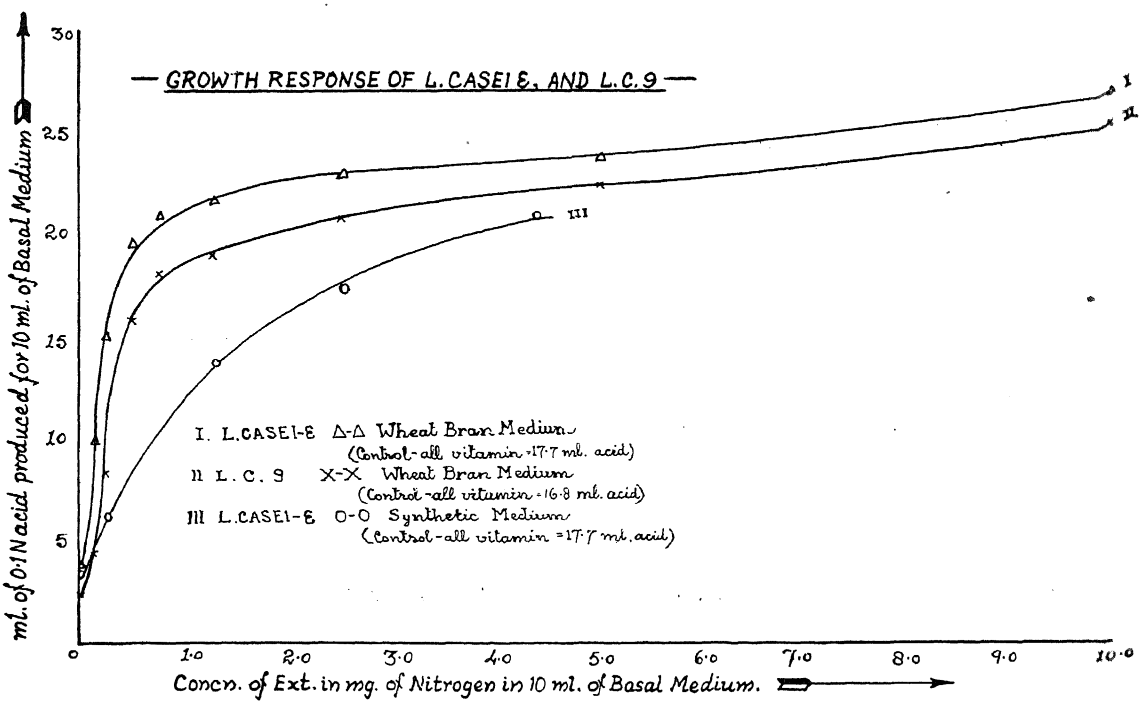

FIG. 1

filtrate could be successfully utilised as a source of growth-promoting factors for certain micro-organisms used in the fermentation industry.

Bacillus subtilis (N.C.T.C.: 2027 N), grown at 37° C. for 72 hours on wheat bran[1] and on a vitamin-free synthetic medium (salt solution = 1·0 ml., starch solution 2 per cent. = 2·5 ml., and ammonium lactate solution equivalent to 2·0 mg. nitrogen, adjusted to pH 7·0 and made up to 10·0 ml.) was found to elaborate amylase. The enzyme extracts treated with 70 per cent alcohol yield the maximum amylase.[2] The alcoholic filtrates were then freed from alcohol under suction at room temperature. The overall growth-promoting potencies of these extracts were assayed microbiologically,[3] with the strains *L. casei-ε* (*N.C.T.C.*, 2080) and *L. casei* 9 (N.C.T.C.: 2087).

Fig. 1 shows that the alcoholic filtrate after enzyme precipitation provides a good source of vitamins of the B-group. With wheat-bran as substrate, a higher concentration of the growth factors is obtained on the basis of the total nitrogen. This might be expected as the wheat-bran itself is a good source of the vitamins of the B-group. A more interesting observation is that the organism on a vitamin-free synthetic medium is able to synthesise not only the amylase but also some of the B-group vitamins. This observation suggests that it may be possible to use the enzyme-free concentrates for fortifying fermentation mashes of the fastidious organisms such as *B. Aceto butylicum*, different strains of yeasts, etc.

The author's thanks are due to Mr. M. Sreenivasaya and Prof. V. Subrahmanyan for their interest in the investigations.

Section of Fermentation Technology and
(later) Dept. of Biochemistry,
Indian Institute of Science,
Bangalore, B. S. LULLA.
August 21, 1947.

1. Beckord, *et al.*, *Ind. Eng. Chem.*, 1945, **37**, 692.
2. Mistry, S. P., Gajjar, I. M., and Sreenivasaya, M., *Curr. Sci.*, 1945, **14**, 95.

RELATIVE EFFICIENCY OF BACTERIA AND PROTOZOA IN THE FLOCCULATION AND OXIDATION OF ORGANIC MATTER SUSPENDED IN WATER

IN view of the earlier observations[1,2] on the flocculating and oxidising activity of certain forms of protozoa in Activated sludge, further experiments were carried out by isolating a number of bacterial strains (eighty-one different forms) from water samples, soils, compost heaps, raw sewage and sludges, and fæces of animals (such as cow and horse) and introducing them singly and in combination with protozoa (*Vorticella* sp. and *Epistylis* sp.) into sterilised suspensions of organic matter (prepared from garden soil, sewage and compost materials) and bubbling air through the suspensions. Parallel studies with Activated sludge were also conducted for comparative purposes.

The flocculating action of the organisms, individually and collectively, was tried on four types of media (soil suspension, sewage, compost extract, and mixture of these materials).

The bacteria, singly or all together, showed relatively poor flocculating activity: *e.g.*, the percentage reduction of permanganate oxidisable matter by all the bacteria after 24 hours' aeration was 25; the corresponding figures for *Vorticella* sp., *Epistylis* sp. and Activated sludge were 50, 56 and 50 respectively.

Nitrifying bacteria were present in all the sources examined, but nitrification was at a maximum only in presence of the protozoa. The percentages of nitrogen conserved or concentrated in the sludges produced by the different bacterial forms were comparatively much less. The percentage of nitrogen concentrated in the sludge from the mixed suspension containing all the bacteria after 96 hours' aeration was 15, and the corresponding figures for *Vorticella* sp. and *Epistylis* sp. were 27 and 35 respectively.

In order to compare the relative efficiencies of the mixed bacteria and the protozoa in flocculating the colloidal and suspended matter of sewage, experiments were carried out by adding washed cells of *Epistylis* sp. (originally removed from the sides of the aeration chambers of the Activated sludge tank) and Activated sludge (at 5 per cent. level) to suspensions of fresh fæcal matter and bubbling air through the suspensions. It was noted that the bacteria present in the media were also flocculated by the *Epistylis* sp. and also by the mixed protozoa present in Activated sludge. The results of one set of experiments are given in the following table (Table I).

TABLE I

Flocculation of bacteria by protozoa

Treatments (100 c.c. of fresh fæcal suspension in each case)	At start: Bacteria (in millions per c.c. of the suspension)	At start: Protozoa per c.c. in the suspension	After aeration for 18 hours: Volume of sludge* in c.c.	After aeration for 18 hours: Bacteria (in millions) per c.c. of supernatant	After aeration for 18 hours: Bacteria (in millions) in sludge
Fæcal suspension only	60	Nil	Negligible†	170	57
Fæcal suspension with *Epistylis* sp.	63	800	9	0·3	3200
Fæcal suspension with Activated sludge	110	850	7	0·1	4700

*Indicates the volume of sludge on allowing the mixed liquor to stand for one hour.

† There was no measurable quantity of sludge but a thin film of deposit.

The above observations show that the protozoa are much more efficient than the bacteria in the flocculation and oxidation of organic matter in sewage and similar media and that the protozoa have a predominating role in the arobic purification of sewage and kindred operations.

The authors thank Dr. Gilbert J. Fowler for his valuable criticism.

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RESPIRATION OF *VORTICELLA*

THE importance of oxygen tension in the life and active functioning of protozoa has been known and some investigations have already been carried out with certain forms of protozoa, such as *Bodo sulcatus*,[1] *Bodo caudatus*,[2] *Trypanosoma lewisi* and *Leishmania tropica*,[3] and *Colpidium campylum*.[4] The oxygen requirement varies with the type of protozoan and one of the highest so far recorded is that of *Colpidium campylum* (cultured in a bacteria-free medium containing only salts) one million cells of which consumed 112·5 cu. mm. of oxygen per hour at 19·8° C.

In the course of our studies on the role of protozoa in sewage purification, we had demonstrated the importance of adequate air supply in maintaining the activity of the protozoa, particularly the *Vorticellids*,[5-7] which are mainly responsible for the purification. In view of the earlier observations of Buswell and others[8] regarding the minimum oxygen requirement for efficient purification of sewage, it was interesting to determine quantitatively the actual oxygen requirements of the organisms responsible for the process. With this in view, the rate of increase of *Vorticella* sp. during aeration of raw sewage was first followed. The figures obtained with four independent batches are cited below.

Samples of raw sewage	Number of active *Voticella* per c.c. after aeration of the medium for: 24 hours	32 hours	40 hours	48 hours
1	720	1240	1460	1680
2	240	660	820	1100
3	480	880	980	1060
4	620	1100	1340	1500

The *Vorticella* sp. was isolated from the aerated sewage samples, and the protozoan cells were rendered free from the adhering bacteria by repeatedly washing them through columns of sterile water.[9] A number of synthetic media were employed for the culturing of the protozoa, but none of them proved satisfactory. Satisfactory activity of the protozoa was noticed when, however, they were kept in a medium containing distilled water, aqueous boiled

yeast extract and cells of a sewage bacterium having the following characteristics: rod-shaped, motile, Gram-negative, indole +, M.R. +, V.P. –, Koser –, saccharose +, inulin –, and gelatin –. When the bacterial culture alone was used (without the yeast extract), the results were not satisfactory.

The respiratory activity of the above protozoan culture was studied by means of the Barcroft differential manometer. 4 c.c. of the culture was measured into the right-hand cup of the manometer and 4 c.c. of the control culture was measured into the left-hand cup; the control material was prepared by heating a portion of the fresh culture to 45° C. for 15 minutes, which process killed the protozoa but not the bacteria. The thermostat was maintained at a temperature of 25° C. and the whole apparatus shaken at the rate of 120 oscillations per minute. The readings were taken at intervals of 5 minutes for about an hour each time, and the observations in regard to the uptake of oxygen and production of carbon dioxide were recorded in the usual way. The oxygen uptake of the control was automatically allowed for by the differential character of the apparatus.

It was noted that, when the protozoa were functioning most actively, 100,000 cells consumed 9·31 c.c. of oxygen per hour (at N.T.P.); their respiratory coefficient for a period of 40 minutes was 0·81.

These data would show that the *Vorticella* sp. actively functioning in the sewage purification process respired at a much higher rate than most of the other forms of protozoa described in literature.

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UTILISATION OF SEWAGE FARMS FOR GROWING SUGARCANE AND PRODUCTION OF WHITE SUGAR

In his recent report to the Indian Council of Agricultural Research, Dutt[1] has made a comprehensive survey of the sugarcane research in India and has suggested methods of developing the potentialities of sugarcane cultivation throughout the country. More recently, Ghosh[2] has given an account of sugarcane and the sugar industry in India. According to his figures, we are still deficit in production of sugar by one million tons annually, the quantity available being 5·3 million tons per annum.

One of the main problems facing the industry is on the agricultural side, and this relates largely to the manurial aspect of the crop. Nitrogen manuring every year is a necessity for sugarcane throughout India, and it has been estimated that the crop requires a minimum of 100 lbs. of nitrogen per acre.

A fairly rich source of nitrogen, phosphorus and other fertilising ingredients which has not been adequately utilised is represented by the enormous volume of sewage discharged from the various towns of the country.[3] The daily discharge of sewage from the major cities alone contains not less than 100 tons of nitrogen in organic combination (equivalent to about 500 tons of ammonium sulphate per day); if similar discharges from the smaller towns and major villages are also included, the total equivalent of nitrogen would be considerably more.

Sewage farming has been practised on a very limited scale at a number of centres in India and at a few stations (*e.g.*, Lucknow and Agra,[4] Jamshedpur,[4] Dacca,[5] and Hadapsar[6]), trials with sugarcane have also been conducted. There is, however, need for further work in this direction, and during the last five years we have been studying, under the auspices of the Indian Council of Agricultural Research, the response of different crops, including certain varieties of sugarcane to domestic sewage and mixtures of textile wastes and sewage.[7] Our observations in regard to sugarcane may be briefly summarised as follows.

Experiments with different varieties of cane (*e.g.*, H.M. 320, Co. 419, Co. 413 and P.O.J. 2878) at Bangalore, Madura and Ahmedabad, have shown that they respond well to sewage irrigation; their yields have varied from 40 to 80 tons per acre, with a maximum of 155 tons at Ahmedabad in small experimental plots. The quality of cane raised on sewage is quite satisfactory. Thus, the cane H.M. 320, grown at Bangalore, yielded juice of Brix 20·71 (17·5° C.); percentage purity, 94·14; sucrose, 19·5 per cent.; and glucose, 0·46 per cent. From this crop, *gul* of good quality and white sugar were prepared (average recovery of sugar, 6 per cent.), and were favourably reported on by experts.

The lands selected for the experiments at Madura and at Ahmedabad were under sewage irrigation continually for about twenty years and for longer periods respectively. The soils in those farms have, therefore, retained more salts from sewage, and under such conditions it was observed that while the crop yields were very high, the juices contained relatively more salts which adversely affected the setting quality of the *gul* and also imparted a saltish taste to the product. The salts in the juices did not, however, interfere with the preparation of 'Khandsari' or white sugar, since they were removed along with the molasses.

Experiments were carried out in the laboratory by adding varying amounts of chlorides of sodium, calcium and magnesium and also invert sugar to normal cane juice (as also to aqueous solutions of ordinary sugar) and processing the juices (and the solutions) for the sugar recovery. The results of these studies would show that these constituents would not

affect the manufacture of good white sugar from the canes grown on the older sewage farms as well.

The above observations indicate that sewage may be hygienically and economically utilised for the cultivation of sugarcane. Such a development would, apart from meeting to a considerable extent the present sugar shortage in the country, also help to utilise the valuable fertilising ingredients which are now largely going to waste.

Further studies in regard to the selection of the best varieties of cane for sewage farming and other aspects are in progress.

The authors wish to thank Mr. N. L. Dutt, the Sugarcane Expert to Government, for his keen interest and valuable co-operation.

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COLOURING MATTER OF THE FLOWERS OF *HIBISCUS ESCULANTUS*

SINCE the study of the colouring matter of a number of flowers belonging to the family Malvaceæ has yielded interesting results in the chemistry of the flavonols, the flower petals of *Hibiscus esculantus* have now been examined. This plant is cultivated throughout India and in all tropical countries as a vegetable. One of the varieties of the flowers are yellow with purple eye spots in the centre.

About a pound of dry flower petals, from a vegetable farm near Madras, was extracted three times with boiling methylated spirit, each extraction taking 6 hours. The solvent was distilled off on a water-bath, and the viscous brown concentrate treated with an equal volume of ether and allowed to stand in the ice-chest for 4 days. A considerable amount of yellowish brown solid separated. The ether layer was poured out and the solid filtered and washed with alcohol. A little more of it separated from the aqueous filtrate on further standing for a few days. The crude product weighed 2 grams. After repeated crystalisation from dilute alcohol it was obtained in the form of bright yellow narrow rectangular plates melting with decomposition at 230°–320° C. It was readily soluble in water giving an yellow solution, but sparingly soluble in alcohol and other organic solvents. It gave a dark olive green colour with ferric chloride and a red precipitate with neutral lead acetate. Its solutions in dilute alkali and in alkaline buffers were yellow and did not exhibit any rapid change of colour. It was unaffected by *p*-benzoquinone in alcoholic solution.

The substance was glucosidic in nature, and on hydrolysis by boiling with 7 per cent. sulphuric acid yielded glucose and a bright yellow aglucone crystallising from alcohol as prisms and melting with decomposition at about 310°. Its colour reactions with alkaline buffer solutions were characteristic of gossypetin—yellow green blue, and finally fading. Its identity with gossypetin was confirmed by direct comparison and also by preparing the acetyl derivative, m.p. 226°–28° C., and determining the mixed melting point with an authentic sample.

The original colouring matter is, therefore, a glucoside of gossypetin, and all its reactions agreed with the rare 8-glucoside, gossypin.[1,2] This was established by direct comparison and determination of the mixed melting point. It was first isolated from the flower petals of *Gossypium indicum*[3] but this is a poor and unreliable source. More recently the flowers of *Hibiscus vitifolius*[4] were found to contain it in quantity. *H. esculantus* forms a third source though not so rich. Thus gossypin is more widely occurring in nature than originally expected.

The ether solution and the aqueous mother-liquor were examined for the possible presence of other components, but none could be isolated.

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MERCUROCHROME AS AN INDICATOR IN HALOGEN AND SILVER ION TITRATIONS

IN continuation of the study of mercurochrome (disodium-dibromo-hydroxy mercury fluorescein) as an indicator[1] the present investigation was undertaken. Standard solutions (M/20) of potassium chloride, potassium bromide, potassium iodide, and silver nitrate were employed, one per cent. aqueous solution of mercurochrome being used as indicator. Finally the readings were compared with those obtained when potassium chromate was used as an indicator in accordance with the known standard methods.

To 10 c.c. of a halide solution a couple of drops of the present indicator were added. As the silver nitrate solution was run in, a whitish turbidity occurred, which changed to pink. This change of colour was sharp only in the case of potassium iodide (and not so marked in the other two cases), marking the end point. The following modification im-

proved the appearance of the end point in all the three cases. To each lot of the halide solution, 10 c.c. of a mixture of sulphuric and phosphoric acids* and 2-3 drops of the mercurochrome indicator were added. The appearance and persistency of the pink colour marked the end point. The readings corresponded with those obtained by using potassium chromate indicator.

The advantages of the present indicator in these titrations as compared to potassium chromate are obvious.

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1. Airan, *Nature*, 19, July 1947, p. 88.

* 15 c.c. of conc. sulphuric acid and 15 c.c. of phosphoricacid were mixed, and the solution made upto 100c.c.

CHEMICAL EXAMINATION OF THE LEAVES OF *ADENANTHERA PAVONINA* LINN.

THE decoction is made from the leaves of *Adenanthera pavonina* Linn. in South India and given as a remedy for chronic rheumatism and gout. If used for any length of time it is said to be anaphrodisiac. It is regarded as useful in hæmorrhage of the bowels and hæmaturia.[1]

The chemical examination of the leaves has been carried out. The air-dried leaves (25 gms.) were extracted with solvents with the following results:

Extracts with	Residue %
Ether	14·7
Chloroform	1·028
Acetone	13·6
Alcohol	2·248
Water	26·768

Only the alcoholic extract showed the presence of an alkaloidal substance with a m.p. 88° C. A large-scale examination of the leaves to obtain the compound in quantity and in a purer form is being carried out.

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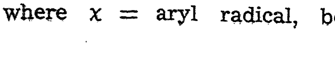
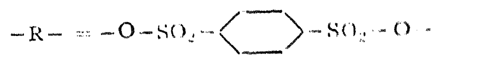
SOME BENZENE 1:4-DISULPHONIC ACID ESTERS

CARR and Brown[1] have synthesised a number of p-alkoxy benzene sulphonic acid esters as possible local anæsthetics. Sen[2] has made a systematic study of the action of toluene sulphonyl chloride on phenols. With a view to studying the chemistry and pharmacological properties of disulphonic acid esters of the type



where x = aryl radical, benzene-1:4-disulphonyl chloride has been reacted with eleven aromatic hydroxy compounds in acetone solution in presence of sodium carbonate or diethyl-aniline and the resulting esters have been isolated and characterised. The phenolic compounds and the esters isolated along with their melting points are recorded in Table I.

TABLE I



Sl. No.	Phenol used	Product	m.p. °C.
1	Phenol	$R(C_6H_5)_2$	167–168
2	O-nitrophenol	$R(C_6H_4{-}NO_2)_2$	176–177
3	*p*-nitrophenol	$R(C_6H_4\cdot NO_2)_2$	240 (decomp.)
4	O-chlorophenol	$R(C_6H_4{-}Cl)_2$	183–184
5	*p*-chlorophenol	$R(C_6H_4{-}Cl)_2$	224–225
6	*m*-cresol	$R(C_6H_4\cdot CH_3)_2$	180–181
7	*p*-cresol	$R(C_6H_4\cdot CH_3)_2$	163–165
8	2:4 dinitrophenol	$R[C_6H_3(NO_2)]_2$	203–205
9	α-naphthol	$R(C_{10}H_7)_2$	175–176
10	β naphthol	$R(C_{10}H_7)_2$	219–220
11	Methone	$R(C_8H_{11}O)_2$	138–139

Full details will be published elsewhere.

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SOME BENZENE 1:4-DISULPHONAMIDES

IN the vastly expanding field of sulphonamides, data on nuclear substituted sulphonamides and on di- or poly-sulphonamides are meagre, consequent on their reported pharmacological inactivity.[1] But the fact that 3:5-dimethyl-sulphanilamide and aniline 3:5-disulphonamide[1] as also αα'-di-(p-amino-benzene sulphonamido) isopropyl alcohol[2] have some activity would indicate that search for new therapeuticals may profitably be pursued in the field of disulphonamides with basic substituents in the nucleus. As a preliminary in this programme of work, a series of unsubstituted disulphonamides of the general formula, 1:4-$C_6H_4(-SO_2-NHR)_2$ (where R is alkyl, aryl or heterocyclic residue) has been prepared. Benzene-1:4-disulphonyl chloride[3] has been reacted with twenty-four amines and the products, isolated and characterised. They are all soluble in dilute alkali and can be reprecipitated by acid. The amines used and the products isolated are recorded along with their melting points in Table I.

TABLE I

$-R- = -NH-SO_2-$$-SO_2-NH-$

S. No.	Amine used	Product	m.p. °C.
1	Methyl amine ..	$R\,CH_3)_2$	219–220
2	Ethyl amine ..	$R(CH_2CH_3)_2$	172–173
3	2-Pentyl amine ..	$R(CHMe\cdot CH_2\cdot CH_2\cdot CH_3)_2$	123
4	Isopropyl-propyl amine ..	$R\,CHMe\cdot CH_2\cdot CHME_2)_2$	174–175
5	*O*-Toluidine ..	$R(C_6H_4-CH_3)_2$	233–235
6	*p*-Toluidine ..	$R\,C_6H_4-CH_3)_2$	273–274
7	*O*-Xylidine ..	$R(C_6H_3\cdot Me_2)_2$	251–252
8	*m*-Xylidine ..	,,	244–245
9	*p*-Xylidine ..	,,	234–235
10	*p*-Anisidine ..	$R(C_6H_4-OC_2H_5)_2$	233–234
11	*p*.Phenetidine ..	$R(C_6H_4-OC_2H_5)_2$	252–254
12	*O*-Chloraniline ..	$R\,C_6H_4\,Cl)_2$	275–276
13	*p*-Chloraniline ..	,,	291–292
14	*m*-Bromaniline ..	$R(C_6H_4\cdot Br)_2$	249–250
15	α-Naphthylamine ..	$R(C_{10}H_7)_2$	285–286
16	β-Naphthylamine ..	,	263–265
17	*p*-Phenylene diamene ..	$R(C_6H_4)$ 1 : 4	340 (decomp.)
18	Benzidine ..	$C_6H_4\overset{R}{\diagup\,\_\,\diagdown}C_6H_4$	300 (decomp.)
19	*O*-Toluidine ..	$C_6H_3CH_3\overset{R}{\diagup\,\_\,\diagdown}C_6H_3\,CH_3$	310 (decomp.)
20	α-Aminopyridine ..	$R(\alpha\text{-}C_5H_4N)_2$	279–281
21	Sulphanilamide ..	$R(C_6H_4SO_2\,NH_2)_2$	297–299
22	4–4′ Diamino diphenyl sulphide ..	$R\langle{C_6H_4 \atop C_6H_4}\rangle S$	316 (decomp.)
23	44′ Diamino diphenyl sulphone ..	$R\langle{C_6H_4 \atop C_6H_4}\rangle SO_2$	285 (decomp.)
24	Phenyl hydrazine ..	$R(NH-C_6H_5)_2$	169–170

Full details will be published elsewhere.

Our thanks are due to Mr. R. B. Kale for participating in this work in its preliminary stage.

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CONGO RED AS ADSORPTION INDICATOR

FOLLOWING the discovery of Fajans,[1] a large number of acidic and basic[2] dyestuffs have been employed as adsorption indicators in argentometric titrations. Recently, the applicability of a number of acidic dyestuffs has been demonstrated in communications[3,4,5] from this laboratory.

Congo red (diphenyl-dis-azo-α-naphthylamine -4-sulphonic acid) has been shown to exhibit a marked colour change from blue to red at a pH range 3–5. It has both the sulphonic acid groups and the basic amino groups in the molecule. So it was expected that the dye would show a remarkable colour change when used in precipitation reaction, and it might be possible to use the dye both in estimating halide ions against silver ions for which, acidic indicators like fluorescein have been used before, and also in the opposite case, *i.e.*, the estimation of silver ions by halide ions for which the basic dyes like rhodamine have been used.

When a chloride solution (N/10) is titrated against silver nitrate with a drop of 0·2% indicator in neutral medium, the silver chloride precipitate assumes a pink shade at the equivalence point. But the pink colour of the precipitate cannot be removed by the addition of an excess of the chloride solution. However, when the pH of the medium is maintained between 3 and 5 (the range in which the indicator itself exhibits a colour change), the colour change is quite reversible. Thus when 10 c.c. of potassium chloride (N/10) was mixed with two drops of the indicator and 2 to 3 c.c. of N/1000 solution of nitric acid, and titrated against silver nitrate solution (N/10), the silver chloride particles were blue in colour so long as the chloride ions were in excess, due to a preferential adsorption of the basic form of the indicator. Just at the equivalence point, half a drop of the silver nitrate in excess turned the precipitate

pinkish in shade, due to a preferential adsorption of the acidic form of the indicator. The end point is quite reversible, and after the end point has been exceeded, a drop or two of the potassium chloride solution again turns the pink precipitate blue.

Further work with the indicator is in progress.

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1. Fajans and Hassel, *Z. Elektrochem.*, 1923, **29**, 495. 2. Hodakow, *Z. Phy. Chem.*, 1927, **129**, 128. 3, Mehrotra, Tewari and Dube, *Curr. Sci.*, 1947, **16**, 119. 4.—, *Ibid.*, 1947, **16**, 254; 5.— *Proc. Nat. Acad. Sci. Ind.*, **1946**, **15**, Part 4.

EFFECT OF STORAGE ON THE ALKALOIDAL CONTENT OF *STRYCHNOS NUX-VOMICA* SEEDS

THE effect of some conditions of storage on the constancy of the alkaloidal content of *Strychnos nux-vomica* was reported[1] from this laboratory in 1932. Since then the seeds (from Shriharikota, Nellore) stored in a gunny bag in the humid atmosphere of Dehra Dun (average annual rainfall 85", about 60" of which occur in July-August) have been tested from time to time for appearance and for total alkaloidal and strychnine content. The results are given in the following table.

Effect of storage of Nux-vomica *seeds on the Alkaloidal content*

Time of storage (months)	Total Alkaloidals (on dry basis)	Strychnine (on dry basis)
0	2·75	1·20
1·5	2·65	1·15
2·5	2·60	1·20
14·5	2·55	1·23
26·5	2·76	1·21
38·5	2·63	1·20
50·5	2·55	1·23
62·5	2·62	1·30
74·5	2·58	1·26
104	2·68	1·27
194	2·70	1·17

The above data clearly show that for the last sixteen years the total alkaloidal and strychnine contents of the seeds have remained practically unaltered. The seeds also have not so far exhibited any lessening of their bright and silky appearance. It may, therefore, be stated that, for the purpose of storage, the mature seeds should be collected and stored in gunny bags in the usual way till required for the preparation of the tincture or the manufacture of strychnine and brucine. In this connection attention may be drawn to the poor grade seeds that are occasionally met in the trade. The poor quality is due mainly to the initial low alkaloidal content of seeds from the same or closely allied species from different localities and not to any deterioration caused by long storage.

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1. Puntambekar and Krishna, *Quarterly J. Pharm. & Pharm.*, 1932, **5**, 633.

CHEMICAL EXAMINATION OF THE SEEDS OF *DERRIS SCANDENS*

CERTAIN species of Derris, especially *D. elliptica* and *D. ferruginea*, are very useful plant insecticides due to their toxic constituents, rotenone and allied compounds, known under the name Rotenoids. The roots of *Derris scandens* were first examined by Krishna and Ghose[1] while making a survey of rotenone-containing vegetable insecticides of India, and they reported the absence of rotenone in them. Clark[2] as well as Rao and Seshadri[3] came to the same conclusion, but obtained scandenin as the major component which was found to be markedly toxic to fish. The seeds of *D. elliptica*[4] and *Tephrosia candida*[5] have been reported to contain small amounts of rotenone. A sample of the seeds of *D. elliptica* from Mysore gave a positive Durham test.[6] With a view to isolating any crystalline toxic component, specially scandenin that might be present in the seeds of *D. sandens*, the present investigation was carried out.

The crushed seeds were first extracted with petroleum-ether by cold percolation, and the extract on concentration gave an oil (yield: 10·0 per cent.) having the following characteristics.

Colour: Golden yellow.
Lovibond scale through 1 *cm. cell*:
Yellow 22·0; Red 4·0.
Taste: Slightly bitter and irritant.
Specific Gravity (30° C.) 0·9125.
Refractive Index (30° C.) 1·4645.
Acid Value 0·920.
Iodine Value (Wij's) 101·50.
Sap. Value 169·20.
Unsap. Matter 1·50 per cent.

Detailed investigations regarding the glyceride structure and the fatty acid composition of the oil are in progress and will be published soon.

The unsaponifiable matter was a soft yellow mass; and it gave strong colour reactions for the presence of fairly good amounts of phytosterols. Two crystalline fractions could be obtained. *Sterol Fraction A*: Crystallized from acetone-methyl alcohol mixture in the form of small hexagonal plates, m.p. 116°-17° C.; deep blood-red colour turning to brown after standing for 4 hrs. (Salkowski reaction) and a play of colours from reddish brown, pink, blue to green (Lieberrmann-Buchard reaction); acetyl derivative crystallised from hot alcohol, m.p. 112°-13° C. *Sterol Fraction B*: Crystallised from acetone in broad rectangular plates, m.p. 137°-38°; strong colour reactions as for fraction A; acetyl derivative crystallised from hot alcohol, m.p. 133°-34° C. In addition, a

soft yellow mass, melting at 70°-80° C., was left, from which no crystalline derivative could be obtained, but still it gave sterol reactions. Detailed characterisation of the fractions is also being done.

The residue from petroleum-ether extraction was extracted in the cold with chloroform. The extract was concentrated to a small bulk, and four times its volume of ether added to isolate any scandenin present which is sparingly soluble in ether. No solid separated even after standing for some days in an ice-chest indicating the absence of scandenin.

Further work on the other constituents of the seeds has also been taken up.

Our thanks are due to Prof. T. R. Seshadri for his suggestions and kind interest in this work.

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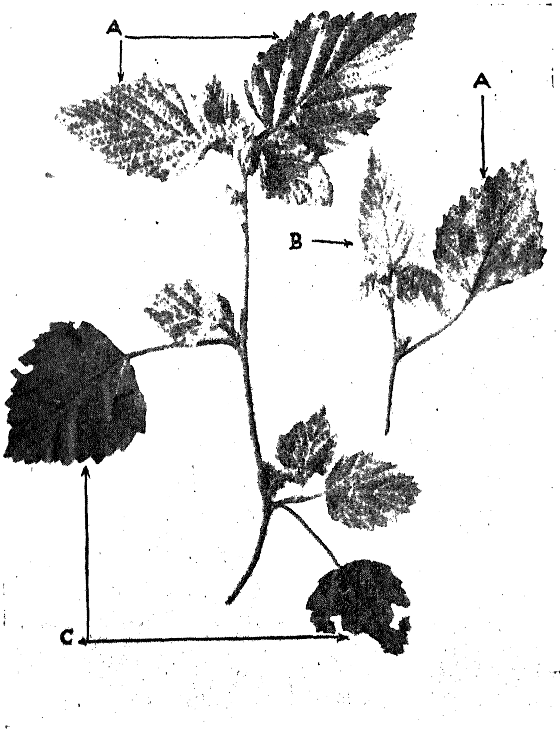
S. Sankara Subramanian.
Dept. of Chemical Technology,
Andhra University,
Waltair,
October 1947.

1. Krishna and Ghose, *Indian Forest Leaflet*, 1942, No. 20. 2. Clark, *J. Org. Chem.*, 1943, **8**, 489. 3. Rao and Seshadri, *Proc. Ind. Acad. Sci.*, 1946, **A**, **24** 365. 4 Holman, "Vegetable Insecticides," *Imp. Inst. Bulletin*, 1940. 5. Krishna and Ghose, *Curr. Sci.*, 1938, **6**, 454. 6. Worsely., *Ann. Appl. Biol.*, 1937, **24**, 696.

MOSAIC DISEASE OF *MALVASTRUM COROMANDELIANUM* GARCKE

Malvastrum coromandelianum Garcke* (Syn: *Malvastrum tricuspidatum*, A. Gray, and *Malva coromandeliana* Linn.) belonging to the Natural Order Malvaceæ, is an introduced weed common in roadside and waste places in several parts of India. I have had under observation for some time in Bangalore a vein-clearing mosaic of this plant hitherto unreported in the literature of the subject. The first symptom on young and old leaves is a clearing of the veins (A in Fig.), the interveinal areas being green. In very old attacks, the affected leaves show a general yellowing (B in Fig.). The vein-clearing symptom is prominent on young leaves. Old leaves remain green. Some branches of infected plants are green and healthy. In many cases old leaves may be green, while the branches arising from their axils are chlorotic (C in Fig.). Affected leaves do not show any malformation or rugosity, except a reduction in size. There is a tendency in some cases for the leaves to show an upward curling. No enations or foliar growths as have been described for the virus disease of Sakel cotton occur in *M. coromandelianum*. There is a dwarfing of the entire plant. The condition resembles the vein-clearing mosaic of bhendi (*Hibiscus esculentus* L.), of Uppal, *et al.*[1] and the A-type of infectious chlorosis described by Hertzsch[2] for *Kitaibelia vitifolia* (Malvaceæ). It has no resemblance to the A-type infectious chlorosis of *Abutilon indicum*, and *Sida napœa*, described by Hertzsch[2] where the leaves have no chlorophyll, and are small and crinkled. The symptoms are very similar to those of transparent kroepoek (leaf-curl) of tobacco characterized by a curling of the leaves towards the ventral side, and the clearing of the veins, enations being absent.

Mosaic diseases of the wild plants of the Malvaceæ, do not appear to have received the attention in India that their possible connection with the mosaic diseases of the cultivated crops of the same family like cotton and bhendi (*Hibiscus esculentus* L.) would seem to justify. *Malvastrum* is a genus of plants very closely allied to *Malva*, *Sida*, *Abutilon*, etc. Pruthi and Samuel[3] barely mention a virus on *Sida rhombifolia*, which they say is the same as



A. Young leaves showing vein-clearing; B. Leaf showing general yellowing and upward curling; C. Green leaves from the axils of which chlorotic branches arise.

that causing leaf-curl in tobacco. Uppal, Patel and Kamat[4] list a virus only on *Hibiscus esculentus*. According to Uppal *et al.*[1] the first symptom of this yellow mosaic of bhendi is the clearing of the veins; there is no marked mosaic, but only a general chlorosis in the young leaves which may or may not show patches of light green. They were able to transmit the virus with the aid of the white fly, *Bemisia gossypiperda* (according to Pruthi and Samuel,[3] Sylvestri considers *B. gossypiperda* to be a synonym of *B. tabaci*, which they have found feeding on *Sida rhombifolia* and *S. cordifolia* among other plants) to *Althœa rosea* and back to bhendi.

Smith[5] reports a mosaic disease of *Malva sylvestris* L., the common mallow, where the affected leaves are slightly distorted, and occasionally show blistering. Boncquet and Stahl[6] report that mallow, *Malva rotundifolia*, harbours the virus of curly top of the sugar-beet. Carsner[7] has succeeded in transmitting the curly-top of sugar-beet to *Malva parviflora*.

Of special significance in this connection is Owen's[8] description of a mosaic disease of *Malachra alceifolia* of the Malvaceæ, where, in the young leaves, the veins alone are cleared. He describes also a mosaic of *Triumfetta lappula* (Tiliaceæ) showing conspicuous vein-clearing and very sharply defined inter-veinal chlorosis, the two symptoms frequently occurring together on the same leaf. In *Hibiscus esculentus* in Trinidad, the chlorosis is inter-veinal without veinal chlorosis[8]; *Sida* spp. show inter-veinal chlorosis and a very limited amount of vein-clearing. Owen[8] considers the mosaic of *H. esculentus* in Trinidad to be not the same as in India, and to be not of much economic importance.

Since the mosaic disease on *Malvastrum coromandelianum* Garcke, is characterized by a clearing of the veins, a symptom characteristic of the mosaic of *Hibiscus esculentus* in India, there is a possibility of this weed acting as an alternate host for the virus of bhendi mosaic.

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in Mysore, Bangalore, S. V. VENKATARAYAN.
September 23, 1947.

* I am indebted to Sri. S. N. Chandrasekhara Iyer, Government Lecturing and Systematic Botanist, Agricultural College, Coimbatore, for the identification of the plant.

1. Uppal, B. N., Varma, P. M., and Capoor, S. P., *Curr. Sci.*, 1940, **9**, 227. 2. Hertzsch, W. *Beitrage, zur infektiosen Chloro. Zeitschr. f. Bot.*, 1928, **20**, 65. 3. Pruthi, H. S., and Samuel, C. K., *Ind. J. Agr. Sci*, 1942, **12**, 35. 4. Uppal, B. N., Patel, M. K., and Kamat, M. N., *Dept. Agr. Bombay Bull.*, 1935, 176. 5. Smith, Kenneth M., *A Text-book of Plant Virus Diseases*, p. 554. J. & A. Churchill Ltd., London, 1937. 6. Boncquet, P. A., and Stahl, C. F., *J. Econ. Ent.*, 1917, **10**, 392. 7. Carsner, E., *Phytopath.*, 1919, **9**, 413. 8. Owen, H., *Trop. Agr.*, 1946, **23**, 157.

THE DERMAL SCUTES OF *MABUYA DISSIMILIS* HALLOWELL

IN *Mabuya dissimilis*, the scales are enforced by a system of underlying bony scutes, which, Sibtain[1] claimed, "are not definitely marked off from each other at the boundary lines, but are interconnected by means of narrow bridges". Although I have carefully studied the skin of this lizard in alizarin-stained preparations (Fig. 1) and have examined single separated

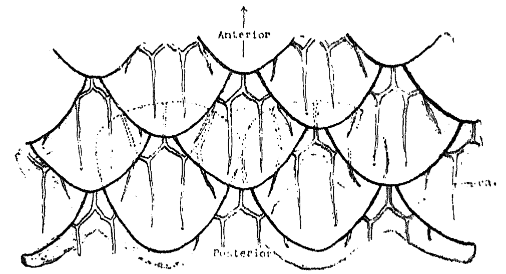


FIG. 1. A piece of normal tail of *Mabuya dissimilis* showing the disposition of scales in relation to scutes. (× **8**) *ca.*, canal.

scutes (Fig. 2) under the microscope, I have failed to discover the interconnecting bridges. The appearance in whole preparations which

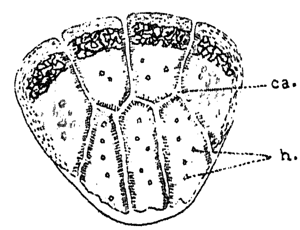


FIG. 2. An isolated candal scale of *Mabuya dissimilis* stained with alizarin and mounted in canada balsam, (× 12) *ca.*, canal; *h.*, hole.

Sibtain perhaps mistook is due to the overlapping edges of contiguous scutes having been made extremely transparent in the preparations.

I am grateful to Professor Beni Charan Mahendra for assistance in writing the present note.

Birla College, SYED MUZAMMIL ALI.
Pilani (Jaipur State),
August 29, 1947

1. Sibtain, *Proc. Ind. Acad. Sci.*, B, 1938, **8**, 67.

A LATENT VIRUS IN TOMATO

A VIRUS which is often carried symptomlessly in tomato, was recovered during inoculation experiments in connection with the studies on "Smalling Disease of Tomato". Inoculations were done on tomato plants grown in the insect-proof house and it was observed that although the Smalling disease is not sap-transmissible the plants so inoculated developed a faint and fleeting mottle. Repeated inoculations showed that this virus could be recovered from large number of tomato plants in the field including those not affected by Smalling disease. The Smalling disease has, however, been shown to be insect-transmitted, the vector being the white fly (*Bemisia tabaci*).

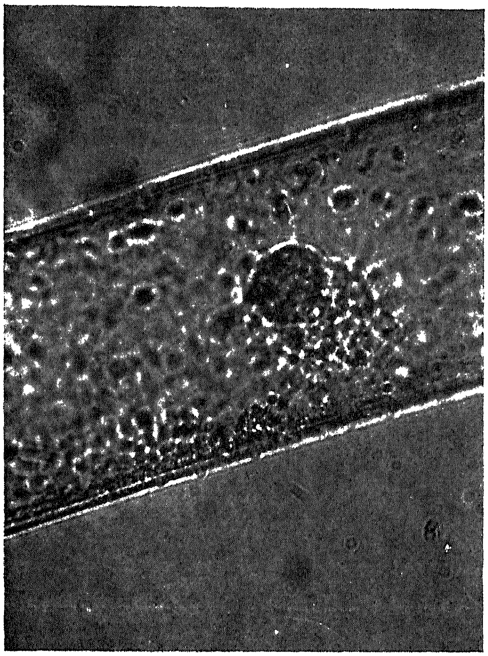
The tomato plants in the field were of the variety, *Suttons' early market*, and the same variety was used throughout the experimental work. For studies on the properties of the

virus, tobacco plants of variety *White Burley* were used since these plants exhibited clear symptoms of the disease. Inoculations were done by rubbing the standard extract on the leaves of healthy plants using carborundum powder as abrasive.

Lycopersicum esculentum Miller. Tomato :—

The tomato plants in the insect-proof house develop a very faint mottling six to twelve days after inoculation. At times the younger leaves of these plants appear pale. The symptoms, however, are transient and after the disappearance of the symptoms the plants look perfectly normal though the virus is carried throughout their life.

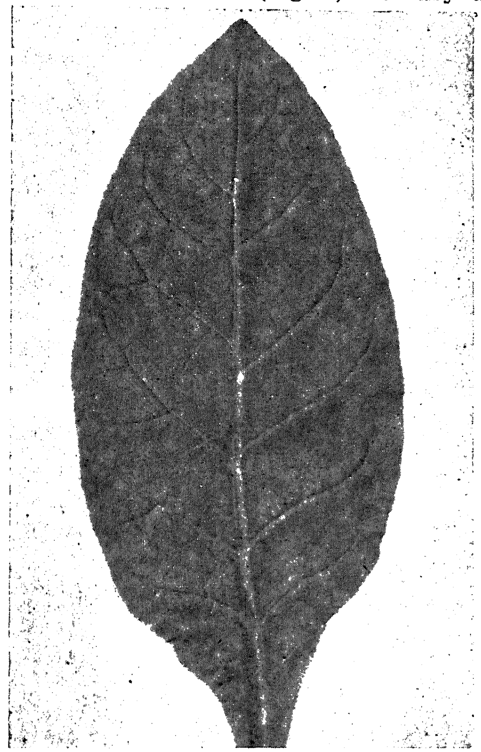
Infected tomato plants develop intracellular inclusions, *i.e.*, typical X-bodies and cubical crystals. The inclusions are usually more prominent in the epidermal hair. Fresh material mounted in water was employed for this purpose. The X-bodies develop only in some of



the cells, usually in the lowermost two cells, and they lie in close association with the nucleus. There is only one X-body in a cell. The nuclei of these cells in which the X-bodies are formed are enlarged and slightly deformed. Often they appear as lobed structures and usually persist in the cell. Only in very rare cases were cells observed with X-bodies in which the nuclei have completely degenerated. In most of the cases the nucleus acquires a sort of depression in which the X-body lodges. The X-bodies were found to develop in the same manner as described by Sheffield.[1] Prior to the formation of the X-body numerous granules appear in the cell which are carried along with the streaming cytoplasms. These granules gradually increase in number and ac-accumulate near the nucleus and finally aggregate to form the typical X-body (Fig. 1). They are usually round and their average diameter is about 25 μ. The crystalline blocks are cubical and their number varies in different cells. The size of crystals also varies in different cells, the bigger ones measuring about 6 μ. In some cells the crystals are found in close association with disintegrating X-bodies.

Nicotiana tabacum L. var. *White Burley* :—

The symptoms develop from six to twelve days after inoculation in the form of light green mottling which generally starts from the tip and periphery of the inoculated leaves. It gradually spreads on the entire leaf and finally to all the other leaves (Fig. 2). Usually the



symptoms remain for a longer period, though ultimately these disappear. The plants, as in the case of the tomato, appeared perfectly normal after the symptoms had been masked.

A number of other Solanaceous plants were tested for the host range of the virus. *Harrison's special* and *German Samsun* varieties of tobacco exhibit similar symptoms as that on *White Burley*.

Nicotiana rustica L., *Nicotiana sylvestris* Spegaz and Comes, *Nicotiana glutinosa* L., *Capsicum annuum* L., *Solanum tuberosum* L. and *Datura stramonium* L. failed to develop any obvious symptoms of infection. Faint mottle was, however, observed on *Solanum nigrum* L.

The virus is rendered innocuous by exposing the expressed sap of the diseased tobacco plants to 59° C. for ten minutes. It withstands dilution up to 1 : 10,000 and retains infectivity in extracted sap for 24 hours at room temperature. The experiments were conducted during the months of January and February in Delhi.

At one stage of the investigation and causal virus was suspected to be a weak strain of

Solanum virus L., but this view was discounted by the immunological tests carried out in this connection.

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September 30, 1947.
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A CASE OF POLYEMBRYONY IN *WAHLENBERGIA GRACILIS* SCHRAD.

Wahlenbergia gracilis Schrad. is a member of the family Campanulaceæ. In the allied family Lobeliaceæ cases of polyembryoni have been recorded for *Lobelia syphilitica* Linn. by Crete[1] and for *Isotoma longiflora* Presl. by Kausik and Subramanyam.[2] In *L. syphilitica* one or two additional embryos develop from the suspensor, and in *I. longiflora* the additional embryo appears to take its origin from one of the terminally situated suspensor cells as a lateral bud.

The development of the embryo in *Wahlenbergia gracilis* closely follows the sequence of development that has been described for other members of the Campanulaceæ and the Lobeliaceæ. In one case two embryos were noticed in the same ovule (Fig. 1) and surrounded by

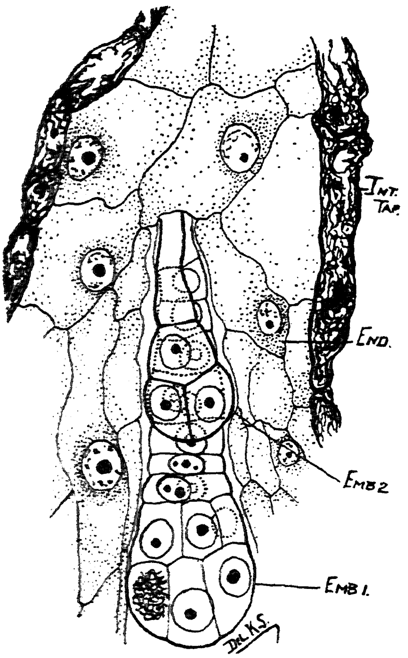

FIG. 1. *Emb.* 1 and 2. The two embryos; *End* Endosperm; *Int. tap.*, Integumentary tapetum. × 616

the endosperm tissue. Of these, one is longer (Fig. 1, Emb. 1) and is at a comparatively more advanced stage of development than the other. The terminal two or three cells of this embryo show vertical walls while the lower cells form the filamentous suspensor. This is the normally developed embryo from the fertilized egg. Over this embryo and superposed over its suspensor the second embryo is seen (Fig. 1, Emb. 2). The terminal cell of this embryo shows a vertical wall. While it is difficult to state how the second embryo has arisen, it is interesting to note that polyembryony, which has been reported in the Lobeliaceæ, should also occur in the allied family Campanulaceæ.

My sincere thanks are due to Dr. L. N. Rao for kind encouragement.

Department of Botany,
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October 29, 1947.
K. SUBRAMANYAM.

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LIVE FUNGI CULTURE COLLECTION AT THE I.A.R.I.

THE foundation of our fungi culture collection was laid in 1936 when a small beginning was made with the object of making available to Universities, Educational Institutions, Mycologists and Plant Pathologists authentic cultures required for training or research. Our collection, being the first of its kind in India, can therefore rightly claim to be a national collection. In 1940 the number of cultures maintained at this Institute was almost 500, of which almost half the collection consisted of fully identified cultures. It was then felt that the staff available in this division for maintaining this national asset and for meeting the demands for cultures from scientists and industrialists was not sufficient. The I.C.A.R. was therefore approached in 1940 for funds to meet the cost of extra staff. The Council considered this work "as of a high scientific and practical value" but at the same time insisted that this activity should form part of the normal work of the Institute". Therefore the Council sanctioned a grant for a period of two years from April 1st, 1943. The Government recognising the maintenance of culture collection to be of a permanent recurring nature, it was made an integral part of the Institute in 1946.

At present the collection consists of 700 cultures of which 325 are of pathogenic and mould fungi.

The one assistant that has been sanctioned for this collection is wholly occupied in carrying out the routine required for such collection. Not much time can be spared for carrying out researches in the maintenance of fungi. However, certain amount of research work is being done. For example, a new method for sealing culture tubes has been evolved as a result of which the longevity of certain groups of fungi is increased. They do not now, therefore, require to be subcultured as often as before.

The utility of this collection, which is of national value can only be increased with the help and co-operation of Mycologists and Plant Pathologists in India.

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October 17, 1947.
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EFFECT OF DIFFERENT TREATMENTS ON THE REMOVAL OF HYDROCYANIC ACID FROM THE BURMA BEAN (*PHASEOLUS LUNATUS* LINN.)

THE existence of a cyanogenetic glucoside in the Burma bean (also known as the Rangoon bean or the Java bean) has long been known and different methods for the removal of the hydrocyanic acid have also been suggested.[1-10] These methods are generally based on the water-solubility of the glucoside and its removal on prolonged soaking in water. Such a procedure also involves loss of dry matter (15-25 per cent.), discolouration, and cracking of the skin on drying. The bean absorbs its own weight of water and the evaporation of that quantity also becomes expensive. Other methods of treatment are also possible by (i) changing the composition of the steep water, (ii) facilitating conditions for interaction between the glucoside and the enzyme present in the bean followed by drying, (iii) prolonged cooking for not less than two hours which removes most of the hydrocyanic acid, (iv) strong heating to destroy the enzyme and (v) still stronger heating (at about 250°C.) to decompose the glucoside. Recently, steeping in presence of sulphur dioxide (as in starch manufacture) or dilute ammonia has been recommended. Interaction between the enzyme and the glucoside takes place in presence of water and, in fact, that procedure forms the basis for the quantitative release of HCN for the estimation. Heating of the dry bean at 120°-150° C. for about ten minutes destroys most of the enzyme, while frying in oil or fat (as for any food preparation) decomposes the glucoside. The human consumer invariably cooks the food, while the animal is fed with the bean or bean-meal, generally, in the raw state. Minute quantities of hydrocyanic acid are harmless and in fact, 2·4-6 mg. is the medicinal dose for certain disorders. 50-80 mg. is stated to be the lethal dose for human subjects. As cases of poisoning have been recently reported, all these factors have to be taken into account when determining the cheapest and the most efficient procedure for treatment.

The Burma bean is now marketed as four distinct varieties: (i) the Double White (Butter bean) variety which we have found to contain 90-160 parts per million (p.p.m.) as HCN; (ii) the single white variety containing 100-300 p.p.m.; (iii) the chocolate brown (Sultani) variety containing 90-140 p.p.m.; and (iv) the speckled variety, 150-350 p.p.m. Some samples of the 'single' white variety are reported to contain over 500 p.p.m. The cases of poisoning recently reported have been mostly traced to the consumption of the single white and the speckled varieties. In actual practice, the two white and the two coloured varieties are likely to get mixed, so that any method proposed should be applicable to even the variety with the maximum hydrocyanic acid content.

Our observations have shown that moistening of the whole bean with 15-50 per cent. water, standing overnight and then sun-drying causes a drop of about 20 per cent. HCN though occasionally higher figures have been obtained. The dry bean when heated for 10-15 minutes at 120° loses about 25 per cent. of the glucoside HCN and practically no free HCN is formed on steeping or cooking in water as the enzyme is destroyed by the previous heating. We have yet no evidence to show that the residual glucoside will not react with the body secretions to form any free HCN.

On making the bean into a flour and then moistening it, the reaction between the enzyme and the glucoside proceeds fairly rapidly. The following were some of the results obtained after moistening the flour, drying it in the open and then cooking the flour with water for 20 minutes.

TABLE I

Variety of bean	Percentage of water added to flour	Hydrocyanic acid content (in p.p.m.): Fresh bean	Wetted and dried flour	Wetted and dried flour after cooking
Single white ..	25	300	69·7	23·8
	50		23·7	22·0
Double white (butter bean)	50	160	48·1	12·0
Chocolate bean (Sultani)	25	140	..	10·3
	50		29·2	2·2

The results show that the moistening of the flour followed by drying offers a potent method of removing most of the free and combined HCN. As cooking will remove further quantity and as flour has got to be cooked for human consumption, this procedure offers definite practical possibilities. The actual working details for large-scale application have, however, got to be worked out.

As moistening and cooking are important factors in the removal of HCN, and as these are invariably employed in the preparation of food, some experiments were carried out with the raw (untreated) flour (passing 20-mesh sieve) prepared out of the Double White (Butter bean) variety containing 160 p.p.m. of HCN, using it in the same way as any other flour for a number of food preparations. The latter were analysed for their HCN contents. Calculations of the quantities of food preparations required for consuming the tonic (medicinal) and the toxic dose were also made. Consumer tests were also carrid out on the preparations made out of Bengal gram, black gram or wheat as the case may be.

It may be noted that the oil-fried preparations contained absolutely no HCN while the others contained only very small quantities. In all the cases, it would be physically impossible to eat such large quantities to reach the toxic dose. The consumer tests also showed that the

TABLE II

Hydrocyanic acid content of food preparations from Burma Bean (Double White—Butter Beans) after being made into Flour

Name of preparation as known and used in South India	HCN (free and combined) in the preparation in p.p.m.	Quantity of the preparation required for the tonic dose (6 mg.) of HCN	Quantity of the preparation required for the toxic dose (50 mg.) of HCN	No. of units that should be consumed for the toxic dose	Maximum possible consumption at a sitting
Iddali ..	3·18	1887 gms. (4 lbs. 2 oz.)	15725 gms (34 lbs. 10 oz.)	393 iddalies	20 iddalies
Dosai ..	Nil	Infinite	Infinite	Infinite	15
Bajjy ..	,,	,,	,,	,,	25
Bagada	,,	,,	,,	,,	50
Bonda ..	,,	,,	,,	,,	20
Upma ..	21·60	278 gms. (10 oz.)	2317 gms. (5 lbs. 2 oz.)	5 lbs. 2 oz.	1 lb.
Kesari-bath ..	11·80	508 gms. (1 lb. 2 oz.)	4233 gms. (9 lbs. 5 oz)	9 lbs. 5 oz.	1 lb
Mysorepakh ..	11·12	540 gms. (1 lb. 3 oz.)	4500 gms. (9 lb.s 15 oz.)	225 slices of usual size	10 slices
Halwa ..	7·34	817 gms. (1 lb. 13 oz.)	6808 gms. (15 lbs.)	15 lbs.	1 lb.
Muruk ..	6·80	882 gms. (1 lb. 15 oz.)	7350 gms. (16 lbs. 3 oz.)	16 lbs. 3 oz.	1 lb.
Ompady ..	7·79	770 gms. (1 lb. 11 oz.)	6450 gms. (14 lbs. 3 oz.)	14 lbs. 3 oz.	1 lb.
Chappati ..	2·38	2521 gms. (5 lbs. 9 oz.)	21008 gms. (46 lbs. 4 oz.)	525 chappatis	20 chappatis
Puri ..	2·38	2521 gms. (5 lbs. 9 oz.)	21008 gms. (46 lbs. 4 oz.)	1751 puris	20 puris
Kuch (thick gruel) ..	5·13	1170 gms. (2 lbs. 9 oz.)	9750 gms. (21 lbs. 8 oz.)	21 lbs. 8 oz.	2 lbs.

preparations were quite satisfactory, and in some cases, even superior to the grains that are generally used in South India.

The use of the bean as flour is distinctly preferable to that in the whole condition. The former can also be used in a variety of ways. Although the results with one variety are encouraging, further work is needed to determine whether mere conversion of the raw bean into fine flour is sufficient in the case of all the varieties. Other methods of treatment are also being studied and the results will form the subject of a later communication.

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S. S. DE.
V. SUBRAHMANYAN.

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Bangalore,
October 27, 1947.

1. Kohn-Abrest, *Mon. Sci.*, 1906, **64**, 797. 2. Arragaon, *Z.*, *Unters. Nahr.-Genussm.*, 1906, **12**, 530. 3. Hendrick, *Trans. Highland Agric. Soc. Scotland*, 1907, **19**, 139. 4. Dunlop, *W. Indian Bul.*, 1915, **15**, 29. 5. Simpson, *Ann. Acad. Cien., Med. fis. nat. Haban*, 1918, **55**, 250. 6. Serrano, *Philippine Agric.*, 1923. **11**, 163. 7. Whintle and Rheinberger, *Z. Unters. Nahra-Genussm.*, 1920, **39**, 346. 8. Berg, *Chem Ztg.*, 1920. **44**, 526. 9. Beythian and Hempel, *Pharm. Zentrah.*, 1920 **61**, 27. 10. Cohn, *Chem. Ztg.*, 1921. **45**, 86, 101. 11. Press reports of methods recommended by the Corporation Chemist and the Government Analysr, Madras.

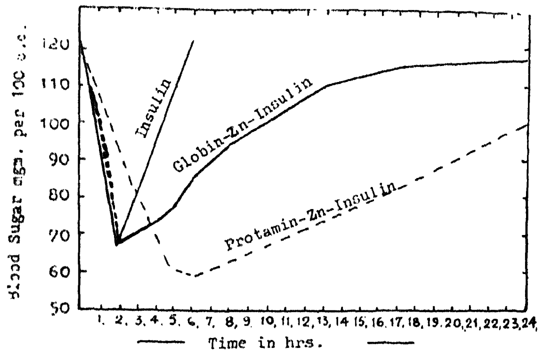
ASSAY OF GLOBIN INSULIN PREPARATIONS

WHILE methods of assay of the potency of Insulin and Protamine-Zinc-Insulin as well as of the determination of the prolongation effect of the latter are described in the literature, no satisfactory method for the assay of Insulin in Globin-Insulin preparations has yet been worked out. The method for the study of the prolongation effect of Protamine-Zinc-Insulin preparations is not strictly applicable for Globin-Zn-Insulin preparations because hypoglycæmic effect of the former is significantly more prolonged than that of the latter, and the criteria suggested for Protamine-Zn-Insulin cannot be applied to Globin-Insulin. This will be apparent from Graph I which represents the average trend of the blood sugar curve under Insulin, Protamine-Zn-Insulin and Globin-Zn-Insulin.

In order to assay the potency of Insulin in Protamine-Zn-Insulin, the suspension is broken and dissolved with acid and diluted with normal saline. The resulting solution behaves like ordinary Insulin for purposes of assay of its potency. The Globin-Insulin preparations are already in solution with a pH between 3·4 to 5. The addition of acid saline to this does not alter the nature of the curve for hypoglycæmic effect. It is, therefore, essential to work out a method for the assay of potency of Insulin in such preparations. A criterion has also to be fixed for the determination of its prolongation effect so that on this basis a sample of

Globin-Insulin can be considered satisfactory for use.

Reiner *et al.*[1] have suggested a comparison of the Globin-Insulin with regular Insulin, the



latter being injected in two portions five hours apart, keeping the total dosage in both cases the same. This method does not appear to have been followed and worked out in detail yet.

We had to test a large number of Globin-Insulin preparations recently and, therefore, had the opportunity of giving this method extensive trials. A comparative study of the hypoglycæmic effect at different intervals with one dose of Globin-Insulin, given at one time and the same dose of regular Insulin in two portions five hours apart has been made in Table I.

TABLE I

	Number of Rabbits	Average Blood Sugar (mgm. per cent.)				
		0	2 hrs.	4 hrs.	7 hrs.	Average. B.S. red
Globin-Insulin 0·5 units/kgm-	20	104·0	68·2	68·0	72·0	33·2%
Regular Insulin given in 2 doses at 5 hrs. interval ·2×0·25 Units/kgm.	20	105·0	64·0	85·2	60·0	30·4%

The average hypoglycæmic effect of Globin-Insulin in seven hours is approximately equal to that of regular Insulin during the same period provided the latter is given in two doses of five hours apart. If, however, the average hourly hypoglycæmic effect of Insulin over a period of five hours is compared with that of an identical dose of Insulin given at the same time, the effect of Globin-Insulin (35 per cent.) has been found to be significantly more than that of Insulin (31 per cent.).

While the hypoglycæmic effect of Globin-Insulin starts early (almost at about the same time as Insulin), and the effect is sustained even at the end of five hours, the effect of regular Insulin would have almost disappeared by this time. This accounts for the higher average with the former.

Central Drugs Laboratory, Government of India, 110, Chittaranjan Avenue, Calcutta,
September 23, 1947.

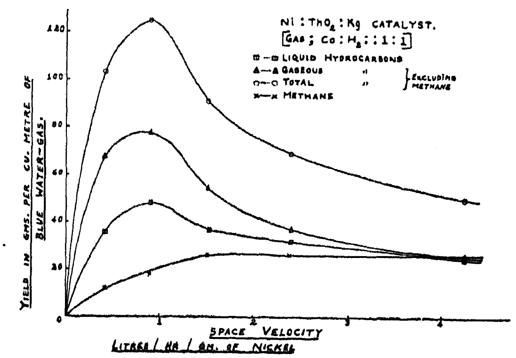
H. BISWAS.
B. MUKERJI.
N. K. IYENGAR.

1. Reiner, L., Searle, D. S., and Lang, E. H., *Proc. Soc. Exper. Biol. and Med.*, 1939, **40**, 171.

Ni-ThO$_2$-KIESELGUHR (100 : 18 : 100) CATALYST FOR THE FISCHER-TROPSCH REACTION. PART II

IN continuation of our previous work[1] we have carried out experiments with the nickel catalyst but with blue water gas ($CO : H_2 :: 1 : 1$) instead of the synthesis gas ($CO : H_2 :: 1 : 2$) previously used.

It was felt that it would be more economical if water gas produced by the reaction of steam and coal, after purification, could directly be fed to the converters instead of enriching the gas with an additional volume of hydrogen. In these experiments it has been found that (*a*) water gas also gives yields of hydro-carbons comparable to those given by the synthesis gas, (*b*) gaseous hydro-carbons preponderate over the liquid hydrocarbons and (*c*) the yield of methane which is much less than what was obtained with 1 : 2 gas, remains almost constant with increasing space velocity which is indeed a desirable feature. It has also been noticed that the maximum yield (about 125 gms. per cu. metre of gas) is obatined with a space velocity of 0·9 litres per gm. of nickel and these findings are in accordance with results obtained by workers in Germany and elsewhere. The yields are plotted against the space velocity in the graph.



The experiments are carried out at atmospheric pressure at 195° C. and the catalyst is found to be very steady.

Dept. of Pure & Applied Chemistry, General Chemistry Section, Indian Institute of Science, Bangalore,
November 1, 1947.

J. C. GHOSH.
N. G. BASAK.
G. N. BADAMI.

1. Ghosh, Basak and Badami, *Curr. Sci.*, 1947, **16**, 318.

REVIEWS

Probit Analysis: A Statistical Treatment of the Sigmoid Response Curve. By D. J. Finney, with a Foreword by F. Tattersfield. (Cambridge University Press), 1947. Pp. xiii + 256 with 23 diagrams and 7 tables. Price 18*sh*.

Probit analysis as a branch of applied statistics is of very recent growth. But this does not make it less useful or important. Modern scientific research in medicine, biology, entomology, toxicology and allied subjects can only be carried out properly with a knowledge of the necessary statistical theory, as Dr. Tattersfield rightly asserts in the Foreword. And in biological assays, where the potency of a new drug or a germicide has to be assessed, statistical method supplies the only tool. But up till now no book was available to the worker in this branch of science (or arts, to be more correct). Mr. Finney is to be congratulated for bringing out this valuable book and thus earning a name as a pioneer. Very few would have been more competent to write such a book as Mr. Finney as he has both the quality and equipment to undertake the task—a sound theoretical knowledge (of the Fisherian technique) and an extensive practical experience.

In writing the book Finney has tried to follow the style of his illustrious teacher, Prof. Fisher, in his famous book *Statistical Methods for Research Workers*. The book is primarily meant for workers practically engaged in biological assays, and so all theoretical discussions have been avoided as far as possible. The computational procedure are well illustrated by copious examples.

The book contains ten chapters, two appendices, seven tables and a list of references. The first two chapters introduce the reader to the problem of biological assays, its difficulty and specific characteristics—the idea of quantal response, and the dosage response curve is also discussed and the LD 50 (median lethal dose) is explained. The problems of probit regression, relative potency, etc., are dealt with in the succeeding three chapters. The modern developments (substantially made by the author himself) such as factorial experiments in biological assays, toxic action of mixtures of poisons (joint action covering similar action and independent action and synergism) and other miscellaneous problems are considered in the rest of the book. The two appendices explain in a nutshell the main practical and theoretical framework of problem. As already pointed out, the book will be of great use to research workers engaged in assessing the toxicity of poisons and allied problems.

The author has tried to write, as far as possible, in non-technical language. Any one with the help of a calculating machine will be able to master the routine procedure of the analysis by following the detailed guidance. The book is illustrated with a large number of examples taken from actual experiment, and the style of writing is lucid. The printing is quite good, but not free from a few mistakes. Thus, on page 117, in the regression equation given in the seventh line, $b_{12}(x_{12}-)x_1x_2$ has been written for $b_{12}(x_{12}-x_1x_2)$.

We congratulate the author for bringing out this volume and hope to see a companion volume of this useful book giving the theoretical treatment of the subject. We are disappointed that the author chose to confine himself to only the probit transformation and has passed over the other important transformations (*e.g.*, 'Logit', etc.) with only a passing remark. In the theoretical book which we expect from his pen we expect also to see not only the probit analysis, but all useful transformations and their practical uses.

A. BHATTACHARYA.

Sound. A Text-Book. By E. G. Richardson. (Edward Arnold & Co.), 1947. 4th Edition. Pp. 344. 18 *sh*.

This is the fourth edition of a well-known text-book on Sound. In the brief compass of 344 pages, E. G. Richardson has succeeded in presenting an up-to-date and valuable account of the latest developments in the subject. As the author rightly mentions in his preface, the position in sound is now very different from what it was about twenty years ago. Applied acoustics has grown considerably in recent years. The author has, therefore, to steer clear of several interesting branches of electro-acoustics, which may really belong to the domain of electromagnetic radiation. Richardson has been able in this book to keep a balance. While giving substantial accounts of recent developments in applied acoustics, he has confined himself strictly to those developments which have a direct bearing on acoustics.

The first five chapters cover the orthodox dynamical theory of sound. Detailed accounts are given of the acoustic vibrations in strings and rods, solids and gases, membranes and plants. In the chapter on 'Vortex formation and jet tones', a full account is given of Aeolian tones and edge tones. Vibrations of air in pipes are considered at length in Chapter VII.

The next chapter deals with fundamental methods relating to analysis of sound. A logical development of acoustic impedance is presented in the next chapter. The production and applications of supersonics are considered at length in a separate chapter. Several interesting facts relating to human voice and hearing are given in the chapter on 'subjective sound'. The last chapter gives a detailed account of the technical aspects of sound. Knowledge on these problems has grown considerably in recent years, particularly in relation to the acoustics of buildings, wireless telegraphy and telephony. Equally interesting are branches of telegraphy such as sound-ranging and depth-sounding.

The book should prove an excellent source of information to the Honours students of physics and to those who desire to undertake research in sound. Copious references to original papers, given at the end of each page, greatly add to the merit of the book.

S. R. R.

The Intelligent Use of the Microscope. By C. W. Oliver. (Chapman & Hall, Limited) 1947. Pp. 182. Price 12/6*d*.

This book is mainly intended to be a guide for the proper understanding of the basic principles underlying the design and function of a microscope together with its associated components.

The book deals in detail with all aspects of microscopic technique and construction. The information is spread over ten chapters which give a lucid and precise account of the main topic under the several headings, such as optical theory, aperture and resolution, the microscope, its components and accessories.

The chapters on measurements and counts is a very welcome feature of the book.

The chapter on "photomicroscopy" deals very thoroughly with all aspects of the problem, and many useful tips are given for working it successfully.

One could avoid repetition, but the idea of the author has been more to emphasise rather than to add to the bulk of the book. The book is a very welcome addition, and greatly fulfils the gap felt till now for a useful and fairly comprehensive book on microscope and its use. It will be a good addition for every one who wishes to use a microscope with the idea of making the best use of the instrument.

T. N. R.

Elements of Tropical Soil Science. By T. Eden. (Macmillan & Co., London), 1947. Pp. viii + 136. Price 5*sh*. net.

Described as 'A text-book of soils, manures and agricultural chemistry in general', intended for the use of practical agriculturists, this hand-book is a welcome addition to the none-too-numerous list of books on tropical agriculture. With its avowed object of being useful to the agriculturist, the treatment of the subject is necessarily elementary and non-technical, but the author has succeeded remarkably well in explaining in simple and clear terms the fundamentals of soil science and their bearing on tropical and, more especially, plantation agriculture.

The book is divided into nine chapters of which the first four are devoted to a description of the soil, its origin and formation, soil varieties, soil profiles and horizons, the physical and chemical properties of soils, etc. The scope and limitations of chemical and mechanical analysis of soils in advisory work is also discussed. However, a more detailed description of the important soil types of the tropics and their distribution would seem to be necessary even in a book of this type.

Chapter five deals with green manuring and compost. As befits its importance in tropical agriculture, the subject is dealt with in some detail. The carbon-nitrogen cycle, the importance of an optimum carbon-nitrogen ratio and the relative merits of green manures and compost are all discussed in clear terms.

The next two chapters deal briefly with cultivation, erosion and drainage as affecting soil texture and fertility. The subject of irrigated agriculture is, however, entirely omitted. One would have welcomed also a more detailed treatment of erosion, particularly erosion control methods.

Fertilisers and their uses are discussed in Chapter eight. The classical theories of Liebig and Lawson are explained, and the question of artificials and organics is discussed at some length. Useful hints on the use of both types of fertilisers are offered.

The last chapter—field experiments—could perhaps have been omitted, without taking away from the value of the book. The agriculturist for whom the book is primarily meant will find the subject dry in spite of the pains taken by the author to explain in simple non-technical terms an admittedly difficult subject.

Taken together, it is a useful book. To the young student aspiring to specialise in agriculture, it offers a first glimpse of soil science in its relation to tropical agriculture. The practical agriculturist, and specially the educated planter, will find in it a book of ready reference which will guide his efforts at crop production and help to co-ordinate and give meaning to his own observations on the field.

Considering the inflationary tendencies everywhere, the price of 5 *sh*. is perhaps justified.

B. D.

Petroleum Resources of India. By D. N. Wadia. (Indian Association for the Cultivation of Science, Calcutta), 1945. Special Publication No. XI. Pp. 34.

We welcome the production of this publication which, we think, has come out at the right moment. Petroleum is essential for the economic development of a country. When our scientists and statesmen are actively engaged in National Planning it pays us to know in advance from an authority like Dr. Wadia what may be the potential petroleum resources of India.

In the introductory chapter the author reviews the oil-bearing belt of Tertiary Paleogene strata which form the extra-Peninsula mountains of North-West India, Assam and Arakan and also carry Tertiary Coal deposits. The three ancient Eocene gulfs of the Indian Sea, Sind-Baluchistan-Punjab gulf, the Assam gulf and the Burma gulf bear petroleum on a commercial scale. The author also discusses briefly the Oil Belts of the World, Theories of the Origin of Petroleum, Petroleum and Coal Relationship, Importance of Geological Structures in Oil Storage and Oil Exploration in India. He refers briefly to the Punjab and Assam oil-fields and the source and the reservoir-rocks of Indian Oil. The future prospects of petroleum in India are very well discussed. In the conclusion the author gives a passing reference to the possibility of synthetic oil production in India by hydrogenation of inferior coals and lignites, which would add materially to our resources.

It appears that the Petroleum industry in India is being overlooked by our planning committees. We shall be extremely happy if this publication of Dr. Wadia improves the situation. We gladly recommend it to all our readers who are interested in petroleum.

H. S. PURI.

Handloom Weaving Industry in India (past, present and future). By M. P. Gandhi. (Published by Gandhi & Co., Jan Mansion, Pherozeshah Mehta Road, Fort, Bombay), 1946. Pp. 58. Rs. 1-8.

This interesting brochure gives at a glance a sufficiently comprehensive picture of the present conditions and future possibilities of the Indian Handloom Industry, with a short historic background. The author who is well known for his several publications on the Cotton Industry has been able, by drawing freely upon the minutes of the meetings of the All-India Handloom Board and its various Sub-Committees as also on the report of the Fact Finding Committee, to compress within the short span of 58 pages a wealth of information supported by statistical data about this vital industry which "is the largest of our small-scale industries" affecting the existence of nearly ten million people, utilising 359·32 million lbs. of yarn and producing 25 per cent. of the country's cloth consumption valued at Rs. 72 crores. Useful practical suggestions for the industry's future development and resuscitation are also incorporated.

The chief problems of adequate supply of grey and dyed yarn in required counts at specified rates, standardisation of quality and price, credit and marketing facilities, elimination of middlemen, co-operative agencies and export markets are touched upon and useful suggestions are made for reorganising the industry with a welcome emphasis on Research and Design.

While the survival of the handloom industry in this age of mechanisation is, in the long run, problematical, one agrees with the author that with such acute cloth famine as now exists in the country, vigorous steps are urgently needed for the immediate rehabilitation of the industry.

A few misprints like 'by' instead of 'to' (p. 9), 'date' for 'data' (p. 10), 'shapes' and 'shares' for 'shades' (p. 25), etc., in an otherwise very readable pamphlet might have been avoided. There also appear to be some discrepancies between the tables given on pages 40 and 41; and also between those on pages 46 and 56.

These minor slips apart, the author has made a valuable contribution towards "educating public opinion for an improvement in the position of this industry". It is a pamphlet useful to every one interested in the welfare of the many who depend on this industry. The price is moderate at Rs. 1-8-0.

SRINAGABHUSHANA.

NEW PERIODICALS

The Calcutta Statistical Association Bulletin, No. 1, August 1947. (The Calcutta Statistical Society, 1/1 B, College Square, Calcutta.) Pp. 48. Price Rs. 1-8 or 3*sh*.

This is a new journal and a welcome addition to the statistical literature in India. The Association has set before itself the fulfilment of two commendable objectives, namely, to promote the study of and research in statistics and to bring home to the Governments and the public the practical utility of proper and dispassionate statistical analysis. That there exists to-day a great need for such an effort in our country can hardly be exaggerated.

The present issue contains popular expositions of certain statistical methods involved in the crop estimation in India, in the survey of public opinion and mental tests. The sections dealing with research notes and critical surveys are very interesting. The latter especially deals with burning problems of the day. A section on the usefulness and necessity of statistical methods in industry would be a valuable addition to the Bulletin since our country is looking forward to an era of planned industrial development.

M. C. SATYANARAYANA.

The Montessori Magazine, Vol. I, 1947. Quarterly. [The Association, Montessori Internationale (India), Pilani, Rajaputana.] Rs. 6 yearly.

In the history of educational thought it is customary to regard Pestolozzi, Froebel and Madame Montessori as belonging to a succession of educators who have devoted special attention to the problem of training the very young. In this trio Madame Montessori occupies a unique place. For, while her predecessors had groped their way in an empirical fashion, the great Italian educationist came to her life-work with a background of medico-psychological knowledge and practice. Her work, therefore, is more truly scientifically experimental in character.

The Montessori Magazine of India, of which the combined issue of the second and third numbers for the months of March and June are here reviewed, is to be commended as a tribute to the world-wide service rendered by Madame Montessori in the cause of school children. As indicated, however, by the editor of the Magazine, there is "a scarcity of concrete, practical contributions of an applied nature in the issue. It is to be hoped that in the days to come this defect will be remedied, and articles of a more lasting character, especially those dealing with Montessori practice and achievement in Indian Schools, will be found.

D. S. GORDON.

Journal of the Science Club, 1947. Vol. 1, No. 1. Editor: K. R. Sen. (The Science Club, 22, Ramesh Mitter Road, Bhowanipur, Calcutta.) Rs. 7-8 per year.

This is a quarterly journal of the Science Club of Calcutta. The sponsors are to be congratulated on this venture at a time when the country's Scientific and Technical progress promises a bright future. The editorial panel is constituted by eminent scientists drawn from both academic and industrial walks of life. The first issue contains articles of high standard in Applied Science on subjects like cotton fibre, planning of Drug Industry in India, and Science News and Notes. The printing and paper of the Journal are of commendable quality. We wish the Journal a long life of useful service to the progress of science in India.

K. S. R.

SCIENCE NOTES AND NEWS

Post-Graduate Field Training in Geology

The Ministry of Works, Mines and Power have made arrangements for post-graduate practical field training in Geology for a number of students selected from the different Universities in India. This measure, which is intended to implement a recommendation of the Geological Education Committee, is being taken now at the intervention of the Hon'ble Mr. N. V. Gadgil, Minister.

The training course which will be for a period of nearly seven weeks beginning about the middle of November 1947, will be held in the field training camps of the Geological Survey of India under the supervision of some senior officers of that Department.

The number of such students to be trained this year will be six.

Nobel Prize Awards for 1947

The 1947 Nobel Prize for Physics has been awarded to Sir Edward Appleton, discoverer of the ionosphere.

His study of radio waves laid the basis for the development of radar. He first proved the effect of sunspots on radio waves and did more to develop long-distance radio transmission and reception than any man since Marconi.

The Nobel Prize for Chemistry has been awarded to Sir Robert Robinson, British authority on the synthesis of natural compounds.

Robinson, who is of Oxford University, received the award for his investigations of biologically important plant products, especially alkaloids. He is famous chiefly for his work on the structure and synthesis of natural products and especially those with a bearing on biological relationships.

Andhra University

The M.Sc. degree of the Andhra University has been awarded to the following research scholars :—

Physics.—V. P. Subramanyam and K. Sriramamurti.

Chemistry.—K. Venkateswara Rao, M. Narasimhachari and M. Narasimha Sastry.

Plans for Scientific Research

The Ministry of Education of the Government of India under Maulana Abul Kalam Azad, has prepared a plan to encourage scientific research and to draw out the latent scientific talent in the country to help industrial development.

The preliminary part of the plan has been already put into operation in co-ordination with the Scientific Man-Power Committee. According to this, India has been divided into four zones and each one placed under one Assistant Educational Adviser. Dr. Sadasivam, Professor, Presidency College, Madras, has been put in charge of the Southern Zone, while Dr. V. B. Shukla, Professor, Science College, Nagpur, is in charge of Western India, including Kathiawar and the Central Provinces. Dr. Sen Gupta has been appointed to the Eastern Zone, while Dr. Narang takes charge of the zone comprising Delhi, East Punjab and the United Provinces.

These Assistant Educational Advisers will visit educational institutions, research centres, industrial establishments, etc., and make a general survey of the position. Their reports will be heard at joint meetings of the relevant departments and, after that, the further plan of action will be chalked out.

A Super-Calculator

Above the College quadrangle at Cambridge, Professor Wilkes has put finishing touches to a two-ton automatic calculator. The "Monster's" name is EDSAC (Electronic delay storage automatic calculator). This new "brain" —first in the world of its kind—will have 25 times more "knowledge" than the American "ENIAC" and will solve mathematical problems so complicated that they are beyond the power of the human brain.

Dr. H. V. Wilkes, Director, Cambridge Mathematical Laboratory, who, with six assistants, is in charge of the astounding calculator, says: "The brain will carry out mathematical research and may make sensational discoveries in engineering, astronomy and atomic physics. It may even solve economic and philosophic problems too complicated for the human mind. There are millions of vital questions we want to put to it."

The wires and valves that make up the calculator "will remember" 500 ten-figure numbers of 1,000 five-figure numbers and will complete 100,000 different calculations per minute, delivering answers to questions on the teleprinter.

The machine "remembers" by storing constantly moving electric and supersonic waves, each representing a number, in circuits of metal tubes filled with mercury. It has 32 mercury tubes, over 1,000 valves and miles of wire.

Prof. B. Sahni

The Government of India have deputed Professor Birbal Sahni for a study tour of the United States, Canada and England. Professor Sahni left India by air on the 20th October, and will be away for about six months.

Prof. Sahni, it is reported, is establishing a Palæobotanical Institute in Delhi to which he has endowed the whole of his movable and immovable property. The Government of India have undertaken to help the development of the Institute by grants towards initial equipment and recurring expenses.

Sugarcane Research

Important decisions were taken to improve and develop the sugarcane industry in India at a meeting of the Indian Central Sugarcane Committee held on November 9th under the presidentship of Sir Datar Singh, Vice-Chairman, Indian Council of Agricultural Research.

A sum of Rs. 53,75,000 was sanctioned for the implementation of the five-year development schemes submitted by the Governments of Assam, Bihar, Bombay, the C.P., Madras,

Orissa, and the U.P., and an advance of Rs. 1,50,000 was permitted to East Punjab. West Bengal has been asked to submit its scheme on the basis of the sugarcane area in the province.

The Indian Central Sugarcane Committee has taken over the Bhadruk Military Grass Farm at Lucknow for purposes of research in sugarcane development. This will help co-ordination of sugar technology with sugarcane culture by establishment of the Central Sugarcane Research *cum* Sugar Technological Institutes.

Indian Coconut Committee

The Indian Central Coconut Committee will hold its next meeting at Bombay on November 26 and the two following days. One of the main subjects expected to be considered at the meeting is stated to be the question of taking over the Coconut Research Station at Kasargod in South Kanara District.

The Research Station at Kasargod is run by the Madras Government. The proposal is for the Indian Central Coconut Committee to take it over and make it a Central Coconut Research Station to conduct research in problems connected with coconut cultivation and coconut technology.

The main problems of coconut cultivation on which research will be undertaken will be insect pests and fungus diseases affecting the coconut palm, the causes of the shedding of tender coconuts termed "buttons" and the possibilities of cross-breeding. It is proposed to cross the tall Indian variety with the dwarf variety of the Andamans. The cross is expected to bear in about five years while the indigenous coconut takes over ten years to bear. Cultural and manurial tests will also be conducted with a view to increasing the production of coconuts per tree. Problems of coconut technology relating to the methods of utilising the various parts of the coconut are also expected to be investigated at the Station.

Indian Institute of Science

The Hon'ble Dr. Syama Prasad Mookerjee, Minister for Industry and Supply, Government of India, laid the foundation stone of the Power Engineering Department that is proposed to be established at the Indian Institute of Science on Monday, the 10th November. The Government of India have sanctioned 60 lakhs of rupees towards the capital expenditure and 4·5 lakhs towards recurring expenditure in connection with this project.

Sir J. C. Ghosh

Sir J. C. Ghosh, Director of the Indian Institute of Science, Bangalore, has been appointed Director-General of Industry and Supply, Government of India. Dr. Ghosh took charge of his new post in New Delhi on November 13.

Radar Contact with Moon

Scientists attached to the Australian Council of Scientific and Industrial Research received radar echoes from the moon on 7th November 1947.

Signals were relayed by land line from Sidney to a short-wave station in Victoria whence they were thrown to the moon, 240,000 miles away, within two and half seconds.

Receiving equipment at Sydney recorded "brittle and compact echoes" for half an hour. Experiments are continuing to prove that the success is reproducible.

Effect of Atomic Radiation

Professor William Greulich has returned after spending five weeks taking measurements and extensive photographs of over 1,000 Japanese children to Stanford University, California. He reports that atom bombs dropped on Hiroshima and Nagasaki had no immediate detrimental effect on human fertility.

Mr. Greulich, who is the Head of the Anatomy Department of the University, cited as evidence a multitude of young babies and pregnant mothers.

The children, however, would be studied up to adulthood to determine the effect of atomic radiation on human growth, development, and reproduction.

Substitute for Jute

The Australian Wool and Meat Producers' Federation has decided to investigate the manufacture in Australia of woolpacks made from low grade wool. Woolpacks, they expect, may considerably solve the packing problem consequent upon a possible shortage of jute.

Paper from Cotton Plant Fibre

According to a report issued by the United States Office of Technical Services, Department of Commerce, it has been found that the woody fibre of waste cotton plants can be utilised in making serviceable paper having a good bursting strength.

600,000-Year-Old Ornaments

A number of tools, ornaments and bones, some dating back 600,000 years, have been discovered by a group of Yugoslav scientists in the Windija Caves in Creatia near the town of Varazdin.

Most interesting among the discoveries was a small stone axe, the smallest ever found in this part of the world, decorated with figures and symbols. Prof. Stepan Vukovie, who headed the scientific expedition, believes that the axe and some similar objects found in the caves served purposes of "voodooism".

Perhaps the most important among the finds was a bone fragment from the top of the skull and seven teeth belonging to the Neolithic Man. Some excellently preserved, lunx teeth as well as joints of pre-historic animals whose identity, however, it was impossible to establish, have also been found.

ERRATA

Vol. 16, July 47, p. 216: In the Contents, *read* C. G. Pendse *for* C. E. Pendse as the author of the Note on "Kinematics of Rotating Frames of Reference". Page 218, first column, line 31: *For* C. E. Pendse *read* C. G. Pendse.

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Current Science

Vol. XVI] DECEMBER 1947 [No. 12

THE INFRA-RED SPECTRUM*

1. INTRODUCTION

THE radiations whose wave-lengths are greater than those of visible light and less than those of the shortest radio-waves constitute the so-called "infra-red spectrum". They are of great interest in relation to several subjects, as for instance, astrophysics, meteorology, thermodynamics and chemistry, to mention no others. The experimental study of the infra-red spectrum presents peculiar difficulties. For the most part, the aid of photography which makes exact studies possible with other parts of the electromagnetic spectrum is not available here. Less satisfactory devices have, therefore, to be employed, which mostly depend on the thermal or heating effect of the rays. As indicated by the Planck radiation formula, the energy of thermal radiation falls off rapidly with increasing wave-length. This makes it difficult to obtain sources of adequate strength for the larger wave-lengths and renders observation and measurement with such wave-lengths difficult and uncertain. A further problem is that of finding suitable materials for prisms which are transparent and have adequate dispersive power in the region under study. Absorption by water-vapour and by carbon dioxide in the atmosphere present other complications. The necessity of exploring the spectrum step by step also makes the work laborious and time-consuming. It is not surprising that in these circumstances our knowledge of the infra-red spectrum has progressed much less quickly than that of the visible or ultra-violet. That such difficulties have been surmounted and useful results obtained by the pioneers in the field is a tribute alike to

* Presidential Address delivered by Sir C. V. Raman. Kt., F.R.S., N.L., at the 13th Annual Session of the Indian Academy of Sciences, held at Cuttack, on the 26th December 1947.

their experimental skill and to their perseverance.

A quickened interest in infra-red spectroscopy is evident at the present time. This is shown by the increased output of literature and also by the several excellent treatises which have appeared of recent years dealing with the field. These developments have doubtless been stimulated by the knowledge which has become available to us since 1928 by spectroscopic investigations on the scattering of light. When monochromatic radiations traverse a transparent medium, the spectrum of the diffused light exhibits new lines, the frequency shifts of which with respect to the incident light represent the characteristic infra-red frequencies of the substance. This way of finding the infra-red frequencies enables us to enlist the powerful aid of photography, since the shifted lines appear in the visible or ultra-violet region of the spectrum; whether the frequency shifts are large or small, they are recorded and rendered accessible to study with the same facility. The insight and knowledge thus derived have proved a powerful stimulus to further study of the infra-red absorption spectra and furnished aid in the interpretation of the results. The infra-red frequencies determined by either method being those of the molecular vibrations in the substance, the two methods are complementary to each other, and also mutually helpful. Quite appropriately, therefore, the results of both methods of study are discussed together in the most recent texts dealing with this field.

It is worthwhile emphasising that studies of the molecular vibration spectra by infra-red absorption or by the scattering of light are not merely of academic interest. Indeed, they have proved to be powerful aids to industry in the chemical and other allied fields. Especially in dealing with organic chemicals are such physical methods more convenient and—with appropriate techniques—also quicker than purely chemical methods of identification or analysis. The vibration spectrum of a molecule is determined by the geometric configuration of the atoms in it, as well as by the atomic masses and the binding forces holding them together. In consequence, the characteristic features of molecular structure reveal themselves by the vibration frequencies, as also by the intensities with which they appear in the infra-red spectra. Hence, the featur of the observed vibration spectra are powerful aid to the identification of th individual substances and to the quantitative analysis of mixtures.

2. Crystals and the Infra-Red Spectrum

Crystals have played a notable part i the development of infra-red spectroscop We have only to recall the fact that th materials which are or could be utilized a dispersive prisms in infra-red work ar crystals. The optical behaviour of suc materials in relation to their chemical natur and physical structure offers much food fo thought. Taking, for instance, the case c rock-salt, the measurements of its refractive index which have been made in th region of wave-lengths between 1 μ and 22 indicate that the vibration frequencies whic effectively determine its dispersion lie i the remote infra-red in the region of 60 μ We may well ask, why is it then that rock salt begins to show an appreciable absorption at 12 μ and exhibits a practically completely cut-off beyond 15·5 μ making useless as a material for prisms beyon that wave-length? Lithium fluoride agai which is another material which has latel come into use for infra-red work, has it effective "dispersion" frequency located a about 32 μ. Nevertheless the materia shows total opacity beyond 16 μ. We ar led to ask, what is the reason for suc opacity?

Standing in close relation to the question raised above, is the remarkable discover made by Rubens and Nichols that a bear of infra-red radiation is monochromatise more or less perfectly if it undergoes series of reflections at the surface of a crystal. This method of obtaining "residua rays" by crystal reflections has been extremely useful in infra-red studies, as i enables a strong beam of specified wavelength to be readily obtained. Variou questions arise with regard to the principl of the method. What relation does the residual-ray wave-length bear to the infra-re frequencies which are effective in dispersion? What thickness of the material i needed to give the desired strength of reflection? What is the relationship between th reflecting power and the absorption coefficient for wave-lengths lying in the regio of opacity?

It is evident that the answers to the questions raised above are closely related to th

fundamental problem of the nature of the vibration spectrum of a crystal and its activity in infra-red absorption. This, in its turn connects up with the question of the relationship between the atomic architecture of the crystal and its infra-red activity. The intimate nature of this relationship will be evident when we consider for instance, the striking difference in behaviour between, say, diamond and rock-salt. The infra-red activity of diamond is extremely weak, while that of rock-salt is extremely strong. Is this difference in behaviour due merely to the difference in the details of crystal architecture, or is it due to the difference bit an absorption curve of the type shown in Fig. 1 in which there is a region of strong absorption between 700 cm.$^{-1}$ and 1500 cm.$^{-1}$, while other diamonds (not so common) do *not* show the absorption in this region. All diamonds, however, show the absorption in the region of higher frequencies beyond 1500 cm.$^{-1}$, and the features of such absorption do *not* show any noticeable differences as between different diamonds. The latter fact makes it clear that the strong absorption between 1500 cm.$^{-1}$ and 2900 cm.$^{-1}$ is a characteristic property of diamond. Why then is the absorption between 700 cm.$^{-1}$ and 1500 cm.$^{-1}$ present

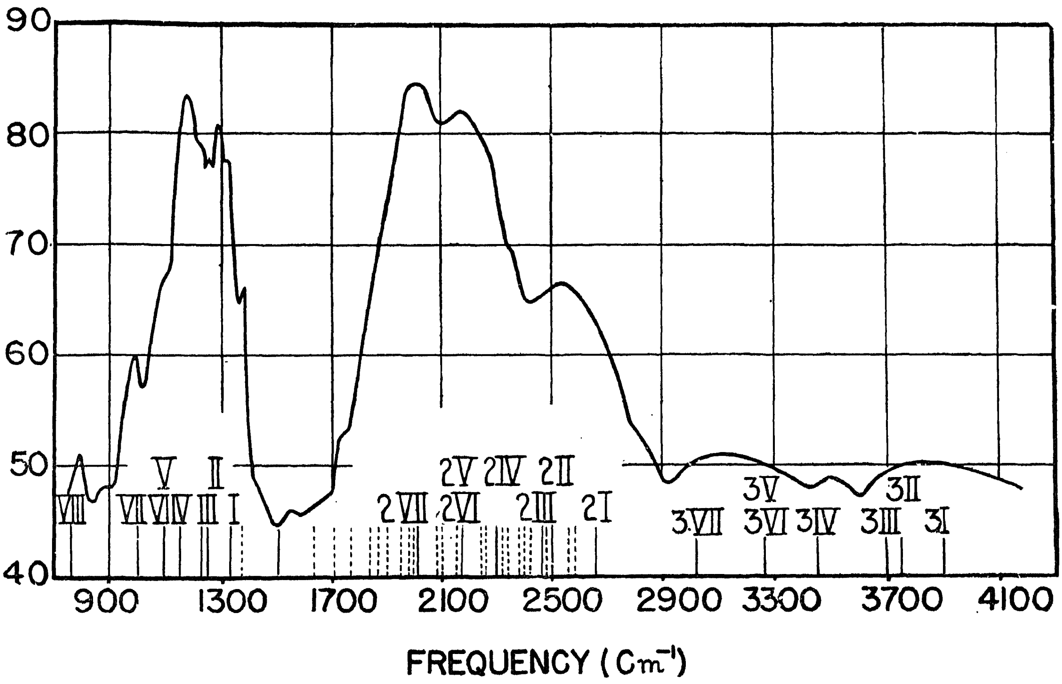

FIG. 1. Infra-Red Absorption Spectrum of Diamond
(after K. G. Ramanathan)

in the nature of the binding forces in the two cases?

The power of infra-red spectroscopy to throw light on the problems of crystal structure is strikingly exemplified in the case of diamond. As mentioned above, the infra-red activity of this crystal is weak, and a thickness of the order of one millimeter is needed to exhibit a readily measurable absorption. Remarkably enough, however, it has been found that the nature of the absorption curve is not the same in all diamonds. The majority of diamonds exhi-

in some diamonds and absent in others? The answer to this question is furnished by the fact that the diamonds which show the absorption are those which exhibit the highest degree of homogeneity when examined by various optical and X-ray methods and which accordingly make the nearest approach to ideal perfection of crystal structure. *Per contra*, the diamonds which do not show the absorption show a visibly laminated structure when examined on the Federov stage under a polarizing microscope, and also various other properties indicating

a notable heterogeneity of structure. It follows that the appearance of the infra-red absorption with the diamonds exhibiting it cannot be ascribed to the presence of crystal imperfections, but must be referred to a fundamental difference in crystal symmetry between the two classes of diamonds, which results in an observable infra-red activity of the vibrations of the structure in one case and its inactivity in the other.

3. The Case of Magnesium Oxide

We shall now proceed briefly to recount the facts which have come to light as the result of experimental studies on the infra-red behaviour of magnesium oxide. Thin films of this substance are readily obtained by deposition of the fumes from burning magnesium, or alternatively by evaporation in a vacuum. Large single crystals of magnesium oxide have also been successfully prepared by solidification from the substance melted at over 2500° C. in an electric furnace. The crystals belong to the cubic class, and can be readily cleaved into flat plates in the same manner as rock-salt. Using the material in various forms, several investigators (Tolksdorf. 1928; Strong, 1931; Fock. 1934; as also Barnes and Brattain, 1935) have investigated the behaviour of the substance in respect of infra-red absorption and reflection. The results reported by these authors are exceedingly remarkable, namely, that in spite of the simplicity of its structure which is similar to that of rock-salt, the crystal has a whole series of characteristic infra-red frequencies in the vicinity of which intense absorption and reflection are observed. Tolksdorf observed a strong absorption at 14·2 μ. Strong found practically complete absorption at 20·8 μ and at 22·9 μ. He also found that at these wave-lengths, the reflection coefficient was 80% and 72% respectively and fell off rapidly with larger wave-lengths. Fock found the most intense absorption at 17·3 μ which he regarded as characteristic of MgO, though his observations also gave indications of other absorption maxima both at longer and at shorter wave-lengths. The most remarkable results of all were those of Barnes and Brattain. These authors studied the reflection coefficient of MgO over the whole range of wavelengths covered by a rock-salt spectrometer, and found a strong reflection between 13 μ and 16 μ with a double peak located at 14·8 μ and 15·3 μ respectively. Even more striking were the infra-red absorption curves in the wave-length range between 6 μ and 15·5 μ recorded by them with five plates of various thicknesses, ranging from the thinnest obtainable to very thick ones. The curves exhibit no fewer than 40 well-defined absorption *lines* in this range.

The facts recited above are irreconcilable with the ideas regarding the spectroscopic

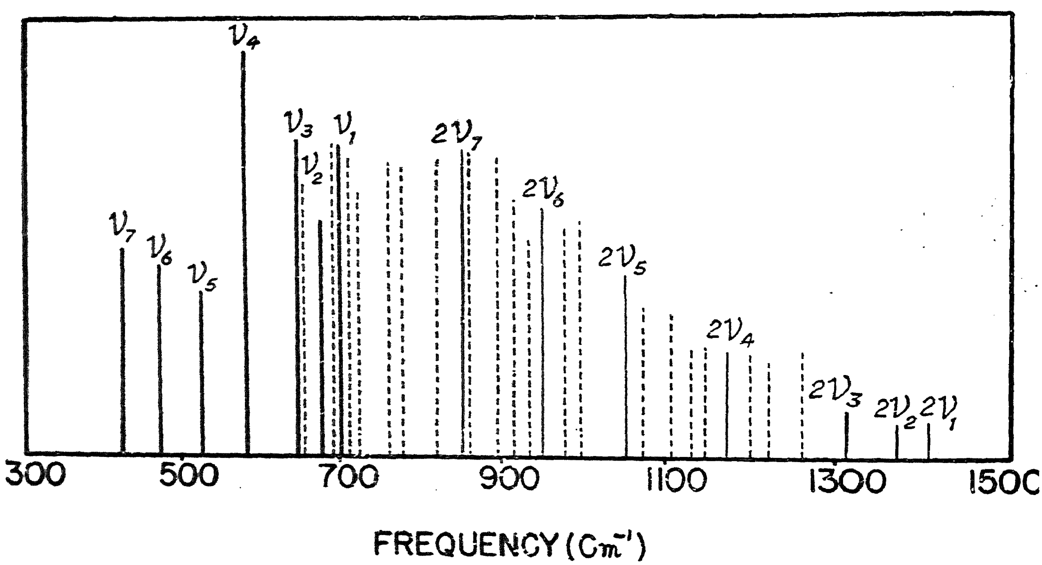

FIG. 2. Infra-Red Absorption Frequencies of Magnesium Oxide

behaviour of crystals derived from the lattice dynamics of Max Born as applied to various actual cases by Blackman, Kellermann and others. Since the structure of magnesium oxide is similar to that of rock-salt, the only mode of vibration of the structure which according to the theory of Born would be infra-red active is the so-called "fundamental vibration" of the lattices of magnesium and oxygen atoms against each other. There would, in addition, be an immense number of other modes of vibration which taken together would constitute a continuous spectrum of frequencies. Actually, the observations indicate that the vibration spectrum of magnesium oxide in the region of infra-red frequencies is not continuous but discrete, consisting of a set of sharply defined monochromatic frequencies, all of which are infra-red active in greater or less degree.

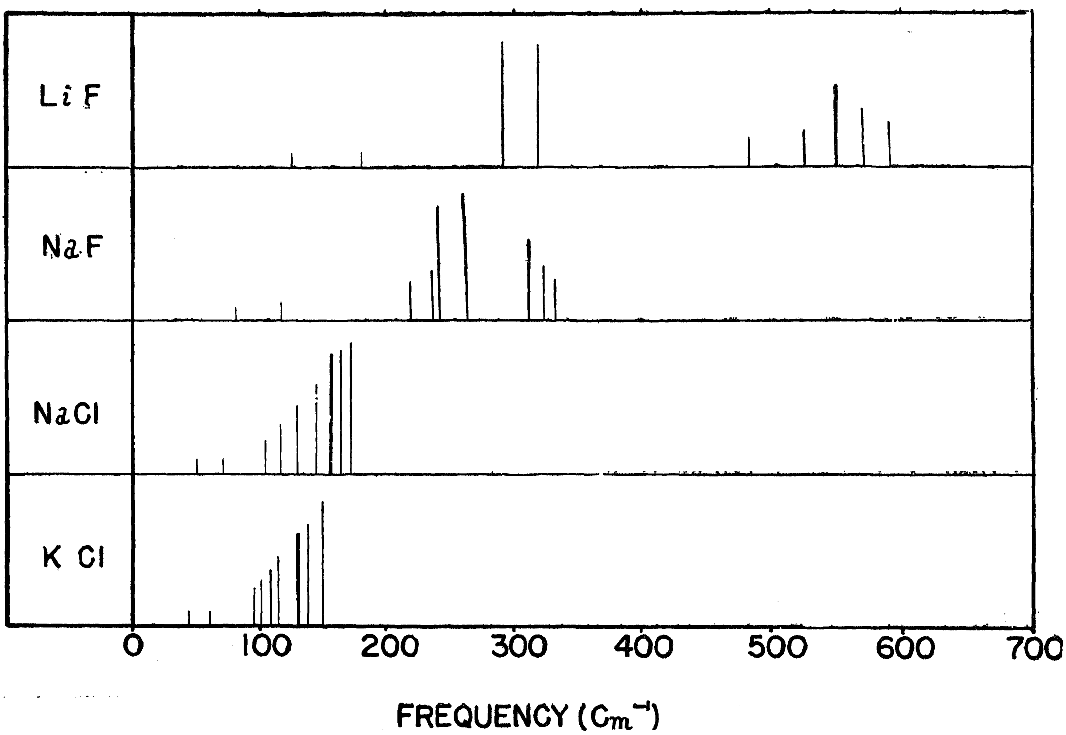

FIG. 3. Eigenfrequencies of Four Alkali Halides

4. THE EIGENVIBRATIONS OF CRYSTAL STRUCTURES

To find an explanation of the remarkable facts detailed above, we have to consider the fundamental problem of the nature of the vibration spectrum of a crystal. The older theories of the subject (Debye, Max Born) approach this from the standpoint of the classical theory of elasticity. They identify the vibrations in the solid with waves traversing its interior in all directions. Such an approach is legitimate in considering the vibrations of low frequency in respect of which the discrete atomic structure of the medium may be ignored and the medium treated as continuous. But in considering the behaviour of a crystal in the infra-red range of frequency, we have necessarily to take into account its discrete structure, and the experimental facts show that the identification of the atomic vibrations with waves of all possible lengths and directions filling the volume of the crystal is not a valid procedure, and that a different approach to the problem is necessary. The fact that the crystal consists of a great many units of very small size which are exactly similar and similarly situated is the very natural starting point for such an approach. Since further, the atomic forces which determine the modes and frequencies of vibration of these units of structure are of limited range, the problem of determining these modes and

frequencies is closely analogous to the theory of the vibrations of polyatomic molecules, except that the units of structure are not isolated from each other and hence it is necessary to consider also their interactions. The problem has been handled by the present writer from this point of view (1943, 1947) and the result is reached that the structure of a crystal containing p atoms per unit cell has $(24p - 3)$ characteristic eigenvibrations. In $(3p - 3)$ of these eigenvibrations, equivalent atoms in adjacent cells of the structure oscillate with the same amplitude and the same phase, while in the remaining $21p$ eigenvibrations they oscillate with the same amplitude but with a phase which alternates in successive cells along one, two or all axes of the crystal lattice. The maximum number of distinct eigenfrequencies is $(24p - 3)$, but this number may be considerably reduced by reason of the crystal symmetry in various actual cases. For crystals of the rock-salt type, $p = 2$, and there are 45 eigenvibrations, but owing to the high crystal symmetry, many of these are similar and the number of distinct eigenfrequencies is only 9. Considered in relation to the entire crystal, these modes and frequencies are of course to be regarded as being very highly degenerate.

5. Evaluation of the Eigenfrequencies

Exact expressions for the 9 eigenfrequencies of crystals of the rock-salt type have been obtained by Mr. K. G. Ramanathan (1947). These expressions have been simplified and used by the present writer (1947) for theoretical evaluation of the frequencies for a number of crystals having this structure, including especially magnesium oxide. The eigenfrequencies of the four alkali halides with the lowest atomic weights as theoretically evaluated are shown on the wave-number scale in Fig. 3. The formulæ as simplified contain four constants, P, P′, T and T′. But P and P′ are nearly equal to each other and are large compared with T and T′. Hence, a further simplification may be effected by replacing P and P′ by a single constant P and similarly also T and T′ by a single constant T, being in each case their arithmetical mean. Even as thus highly simplified, the formulæ are sufficiently accurate to represent the facts correctly. For instance, in the case of magnesium oxide, the 9 eigenfrequencies expressed in wave-numbers come out as **704, 680, 652, 584, 527, 474, 428, 258** and 184 cm.$^{-1}$ respectively. Expressed in infra-red wave-lengths, they are $14 \cdot 2\,\mu$, $14 \cdot 7\,\mu$, $15 \cdot 35\,\mu$, $17 \cdot 1\,\mu$, $19 \cdot 0\,\mu$, $21 \cdot 1\,\mu$, $23 \cdot 4\,\mu$, $38 \cdot 8\,\mu$ and $54 \cdot 4\,\mu$. The first three of the calculated egienfrequencies (ν_1, ν_2, ν_3) are recorded in the observations of Barnes and Brattain made with their thinnest plate as strong and well-defined absorption maxima. ν_4 coincides with Fock's absorption maximum, while ν_6 and ν_7 are those noted by Strong. The octaves of the first seven eigenfrequencies are also represented in the data of Barnes and Brattain as prominent absorption maxima. Some twenty other absorption lines recorded by them are also satisfactorily accounted for as summations of the eigenfrequencies taken two at a time. In Fig. 2 above, the fundamental eigenfrequencies are shown by heavy lines, their octaves by thin lines, and the summational frequencies by dotted lines. ν_8 and ν_9 are less than 300 cm.$^{-1}$ and do not therefore appear in the diagram.

It may be explained here that the constants P and P′ represent the forces arising from unit displacements respectively of the two types of atoms in the structure from their positions of equilibrium, while T and T′ represent the forces on a given atom due to a unit displacement of a neighbouring atom of the same kind. The magnitude of the constants is accordingly a measure of the strength of the interatomic forces which hold the crystal together. The following figures indicate how they differ in the five cases for which the frequency spectrum has been theoretically evaluated.

Table I

Substance	P	T	Units
MgO ..	$2 \cdot 82 \times 10^5$	$-0 \cdot 05 \times 10^5$	dynes per cm.
LiF ..	$1 \cdot 02 \times 10^5$	$-0 \cdot 015 \times 10^5$	,,
NaF ..	6·[illegible]2 $\times 10^4$	$-0 \cdot 10 \times 10^4$	,,
NaCl ..	$2 \cdot 422 \times 10^4$	$-0 \cdot 053 \times 10^4$	,,
KCl ..	$2 \cdot 30 \times 10^4$	$-0 \cdot 05 \times 10^4$	,,

The value of P in the case of magnesium oxide is of the same order of magnitude as the force-constants for covalent bindings known in various cases, and hence in spite of its structure being of the rock-salt type, magnesium oxide is very far indeed from being an "ionic" crystal. It may be mentioned for the sake of comparison that the force-constant P in the case of diamond is

$7{\cdot}54 \times 10^5$ dynes per centimeter. The force-constants in the two fluorides are distinctly smaller than in magnesium oxide, those for sodium fluoride being much less than for lithium fluoride. There is a further large fall in the magnitude of the force-constants in passing from the fluoride to the chloride of sodium, but only a trifling diminution as we pass from NaCl to KCl.

6. The Eigenvibrations and Their Infra-Red Activity

The *third* highest eigenfrequency (ν_3) shown by a thick line in each case for the four alkali halides is that of the mode in which the metal and the halogen atoms move together as groups in opposite phases. (In the Born theory, this is the infra-red active frequency.) The eigenfrequencies ν_4 and ν_5 are those of vibrations in which the lighter atoms alone oscillate, while the heavier atoms remain at rest. ν_6 and ν_7 are the vibrations in which the heavier atoms alone oscillate, the lighter atoms remaining at rest. In NaF and KCl, ν_4, ν_5, ν_6 and ν_7 are all close to each other, owing to the atomic weights of the metal and the halogen atoms being not very different. In NaCl, these four frequencies are more widely separated. In the case of LiF, owing to the great disparity in the atomic weights of lithium and fluorine, ν_6 and ν_7 are much smaller than ν_4 and ν_5. This has some remarkable consequences, as we shall presently notice, on the spectroscopic behaviour of lithium fluoride.

Figs. 4, 5, 6 and 7 represent respectively the reflection coefficients of NaCl, KCl, NaF and LiF in the range of infra-red frequencies in which they are completely opaque except in the thinnest layers. Under each figure, the fundamental eigenfrequencies have been indicated by heavy lines, their octaves by thin lines, and summations of the eigenfrequencies by dotted lines. [The curves have been redrawn on a frequency scale by Mr. K. G. Ramanathan from the observations of Czerny (1930) for the case of NaCl and KCl, and from the observations of Korth and of Hohls (1937) for the two fluorides]. It will be noticed that each of the four curves shows distinctive features of its own. The curve for LiF however stands out from the rest, exhibiting a strong reflection of over 70% over a wide range of frequency which appears separated into two regions by a distinct minimum. The reason for this behaviour, as will be seen from the figure, is that the fundamental eigenfrequencies fall into two widely separated groups. It is particularly remarkable that the group of lower frequency which does *not* include the so-called "active" fundamental ν_3 gives a stronger reflection than the group of higher frequency which includes ν_3. A similar feature also appears in absorption. According to Barnes (1932), the strongest absorption by thin films of lithium fluoride is at $32{\cdot}6\ \mu$ which is midway between ν_6 and ν_7 whose infra-red wave-lengths are respectively

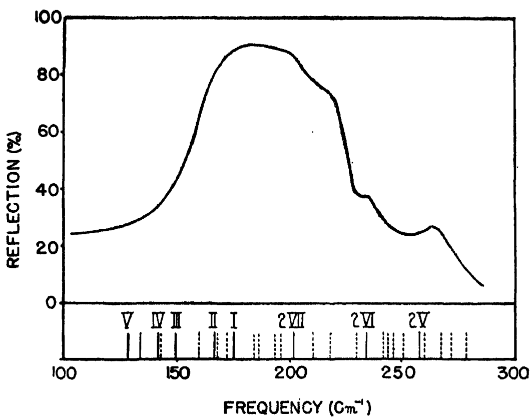

FIG. 4. Reflection Coefficients of Sodium Chloride

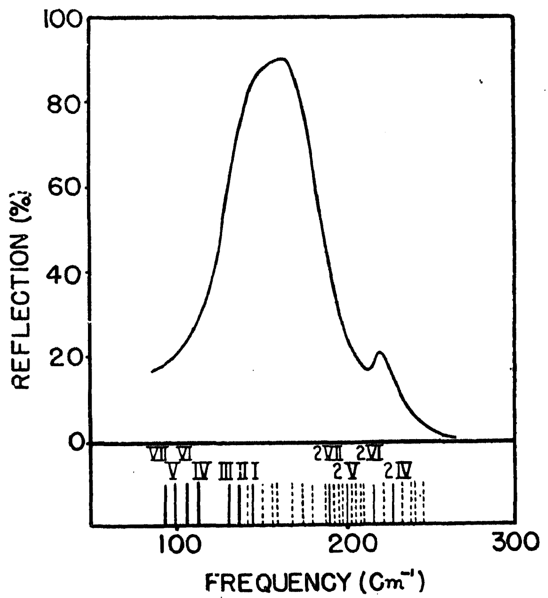

FIG. 5. Reflection Coefficients of Potassium Chloride

$31{\cdot}4\ \mu$ and $34{\cdot}2\ \mu$. In other words, the strongest infra-red activity is *not* that of the mode in which the lithium atoms and the fluoride atom move as groups in opposite

phases, but of the modes in which the fluorine atoms alone oscillate, the lithium atoms retaining at rest.

Surprising as the foregoing results may seem, they are supported by the fact that analogous results are also exhibited by the other crystals, though in a less striking fashion. In the case of sodium fluoride, Barnes (1932) found the maximum absorption by thin films to be at $40 \cdot 6\,\mu$, which is midway between $38 \cdot 3\,\mu$ and $41 \cdot 8\,\mu$, the wave-lengths of ν_4 and ν_5 which are oscillations of the fluorine atoms with the sodium atoms remaining at rest. With magnesium oxide, the strongest absorption by thin films

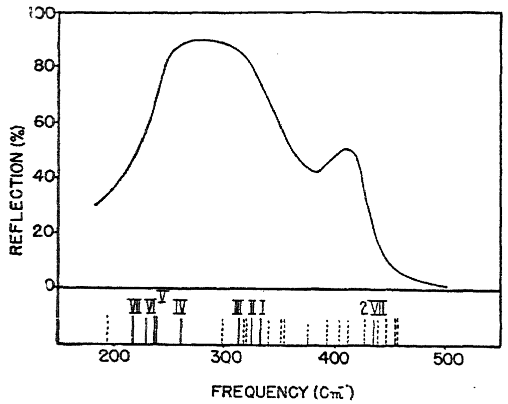

FIG. 6. Reflection Coefficients of Sodium Fluoride

as found by Fock is at $17 \cdot 3\,\mu$, nearly coinciding with ν_4 which is an oscillation of the oxygen atoms against each other, the magnesium atoms remaining at rest. In the cases of NaCl and KCl, the maximum absorption by thin films does not coincide with ν_3, but move nearly with ν_1 which is the highest of the nine eigenfrequencies, being an oscillation of the atomic layers parallel to the cubic planes, normally to themselves, with the metal and the halogen atoms which they contain moving in the same phase.

The fact which emerges clearly from the case of magnesium oxide is that all the eigenvibrations, as also their octaves and their summations, are infra-red active in greater or less measure. The measure of this activity is given by the absorption coefficient at the particular frequency. This has been evaluated by Mr. K. G. Ramanathan from the published data of Barnes and Brattain (1935) and represented on a logarithmic scale of ordinates in Fig. 2. It will be seen that the absorption coefficient falls off rapidly as we move towards higher frequencies. This suggests that the infra-red activity of the various modes in MgO and in the alkali halides is essentially an induced effect, arising from mechanical anharmonicity and consequent coupling with

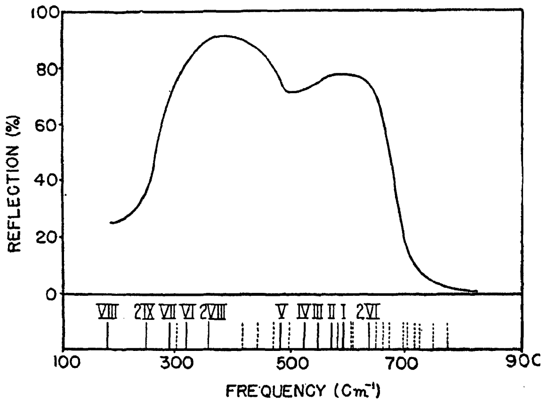

FIG. 7. Reflection Coefficients of Lithium Fluoride

each other of the various eigenvibrations, as a consequence of which all of them become active in greater or less measure, depending principally on their approximation in frequency to the "active" mode ν_3. The activity of the various possible overtones and summations necessarily falls off as we pass successively from the first-order to the second-order spectrum and from the second-order spectrum to the third-order spectrum and so on, the successive limits of frequency of these spectra being set by the highest fundamental and its overtones. The large diminution in the absorption coefficient and consequent improvement in transparency as we move towards shorter wave-lengths is readily understood on this basis.

Fuller details regarding the various topics referred to above, as well as references to the cited literature will be found in papers by the writer appearing in the *Proceedings of the Indian Academy of Sciences* for December 1947.

C. V. RAMAN.

ONE HUNDRED YEARS OF ANÆSTHESIA

N. N. DE

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ANÆSTHESIA has grown from a scientific curiosity in early nineteenth century to an indispensable weapon in the armoury of modern medicine. This article attempts to give a general account of the development of anæsthesia and anæsthetics during the last hundred years. From the most remote periods, surgeons have sought the means to relieve the pain of operations. The internal administration of drugs seems to have been the time-honoured method. In China Indian hemp was used for this purpose. The stupor produced by compressing carotids and thereby producing anæsthesia with the aid of carbon dioxide was employed by the Assyrians, and hypnotism was practised in the East. In later times advantage was taken of the intoxication produced by alcohol. However, the discovery of the means to achieve complete and safe anæsthesia is an accomplishment of the 19th century (1842-1847). The credit of the discovery must be divided among several investigators: Sir Humphrey Davy for his brilliant researches on the chemistry and pharmacology of nitrous oxide, and for suggesting the possibility of using it as a means of anæsthetising patients during surgical operations; C. W. Long for discovery of the anæsthetic properties of ether; Horace Wells for application of nitrous oxide as an anæsthetic; C. T. Jackson and Morton for successful demonstration of the use of ether as a surgical anæsthetic, and Flourens and Sir James Simpson for the introduction of chloroform.

After the discovery of chloroform no major advance was made in general anæsthetics, until about 1923. Since then active researches have recommenced. Ethylene, cyclopropane, evipal and some thio-barbiturates have been introduced, and a wide variety of methods on basal narcosis have been investigated.

MECHANISM OF ACTION OF ANÆSTHETICS

During the last decade or two, anæsthesia has encroached more and more upon the domains of organic and physical chemistry as well as of physiology and biochemistry. In the days gone by, anæsthesia was accepted as such, and no explanation was sought for its action, but now nothing is taken for granted. It has been realised that until some insight is gained into the mysteries of consciousness, our appreciation of the phenomena of anæsthesia will remain inadequate. Strictly speaking anæsthesia means loss of sensation. But the drugs which cause a general loss of sensation also cause loss of consciousness, and this is their most obvious effect. Anæsthesia may be produced in several ways: (1) by temporary paralysis of the sensory nerve endings in the immediate neighbourhood of the part to be operated on (local analgesia), (2) by temporary suspension of the conductivity of the main nerve trunk supplying the affected area (spinal or regional analgesia). But by neither of these methods the patient is rendered unconscious as is the case with (3) administration of a volatile substance through inhalation or (4) by injecting certain substances into the rectum, veins, etc.

Several theories have been advanced, and they are all concerned with the explanation of changes in the nerve impulse and with consciousness. Anæsthesia resembles sleep in many ways, and many of the theories of sleep may with slight modification explain anæsthesia as well. The most important of these are (1) the accumulation of waste products, (2) consumption of intramolecular oxygen, (3) toxin theories, (4) the neuron theory and (5) the anæmic theory. In all these theories it is assumed that there is either a depression of the irritability of the brain cells or the exclusion of stimuli from the periphery or both. Anæsthetic activity is responsible for both of these conditions. The "Mayer-Overton Theory" assumes that anæsthetics act by their solubility in the lipoids of the nerve tissue with consequent fall in conductivity and irritability of the nerve. "The theory of Moore and Roaf" accepts the lipoid solubility but states that the anæsthetic dissolved in lipoid is rendered inactive. According to this view anæsthesia is caused by a loose combination of ether, chloroform, etc., with the protoplasm of the brain cells. The lipoid material, however, absorbs and holds the anæsthetic in contact with the protein and in this way aids the production of anæsthesia. "Verworn's theory" accepts the Mayer-Overton theory to the extent that it explains how the anæsthetic reaches the field of action; but this view holds that real action is due to depression of the activity of the cerebral cells through reduction of their power to carry on oxidation.

MODERN ANÆSTHETICS

The constant increase in the complexity and severity of surgical operations has demanded more and more from anæsthesia, and many of the surgical procedures carried out at the present time require a very high degree of technical skill.

The choice of anæsthetics is a complex problem and is determined particularly by the condition of the patient and the type of operation. Safety is the first consideration, but the depth and duration of anæsthesia, the comfort of the patient and the convenience of the operator are also important.

The several agents that are now in use will be very briefly dealt with, and only certain salient features touched upon. Those that deserve consideration are general anæsthetics, *e.g.*, ether, chloroform, ethyl chloride, vinyl ether, trichlor-ethylene, nitrous oxide, ethylene, avertin with or without morphine and scopolamine and barbiturates, spinal anæsthetics and local analgesics.

The merits and demerits of the volatile anæsthetics are well known and need not be

elaborated here. Suffice it to say that chloroform has been found to be far more dangerous than ether or nitrous oxide, although in the hands of the expert, the acute dangers may be greatly reduced. The chief immediate risks are the induction period. The danger of post-anæsthetic toxæmia makes its employment in prolonged operation almost inexcusable. Ether and nitrous oxide are practically safe in ordinary cases, but nitrous oxide is perhaps the safest form for short operations and in sequence to ether.

A large variety of volatile soluble hydrocarbons has anæsthetic properties and many of them have been studied pharmacologically and clinically. Those that have achieved some practical prominence may be mentioned. *Ethylene* has been used extensively in America, and most observers claim that it possesses many advantages over ether or nitrous oxide. The rapid action and recovery, however, demand close attention on the part of the anæsthetist.

Cyclopropane or trimethylene has been found of great advantage in thoracic surgery although recently it has been largely replaced by kemithal. The supporters of cyclopropane claim that it produces fewer toxic effects than other powerful anæsthetics. It has been used clinically with good results in a considerable number of cases, especially in Wisconsin and Montreal. *Venyl ether* is unreliable in the production of full muscular relaxation, but is largely used for small operations of short duration.

It is well known that the introduction of halogen atoms increases the anæsthetic properties and toxicity of aliphatic narcotics. Mention may be made of ethylchloride, trichlorethylene, and avertin (tribromethanol). The utility of *Ethylchloride* as a general anæsthetic is mainly limited by its extremely volatile nature. Anæsthesia is induced very rapidly, and recovery is equally rapid. It is, therefore, particularly suited for minor operations. The main use of ethylchloride is for local anæsthesia—by freezing the tissue with a fine spray of the liquid. The impossibility of dissecting the frozen tissues restricts its use to simple incisions (opening boils and abscesses). The analgesia is imperfect, and thawing painful.

Trichlorethylene is now generally recognised to have a definite place in anæsthesia in spite of certain disadvantages. It has been given extensive trial, but is probably not a desirable agent for general anæsthesia. It acts as a prompt central analgesic and is used (self-inhaled, using a simple "Draw over" apparatus such as Freedman's) to relieve the pain of trigeminal neuralgia. Muscular relaxation is very poor. It should not be used to produce deep anæsthesia. For light anæsthesia, used as an adjuvant to nitrous oxide, it is probably quite safe. It is very useful in minor surgery and dental practice where surgical anæsthesia is unnecessary or undesirable. Trichlorethylene analgesia is also tending to replace nitrous oxide and air in midwifery in many parts of Britain.

Tribromethanol was introduced under the name "avertin" as a fixed-dose anæsthesia for rectal administration to produce rather evanescent surgical anæsthesia. Reports regarding the safety of avertin are conflicting. It was originally recommended for use as a full anæsthetic, but it is now considered to be dangerous in doses needed to produce this effect. It is used, at present, as a basal narcotic, full narcosis being produced by the administration of nitrous oxide and oxygen.[1]

Many of the derivatives of barbituric acid have been used in medicine for years as hypnotics and sedatives. Since the central effects do not differ in principle from those of the other aliphatic narcotics, certain of the rapidly acting barbiturates can be used alone or in combination to produce true general anæsthesia. The chief difference lies in the non-volatality. They cannot, of course, be administered by inhalation but by mouth, rectum, hypodermically or intravenously. The non-volatility also entails a more prolonged and continuous action. This secures steadiness but restricts flexibility. The latter is a distinct disadvantage, as the anæsthetist can do nothing to lighten the effects if they are too severe. The duration of anæsthesia is also another disadvantage. The use of barbiturates as the chief agents of anæsthesia has, therefore, been considered to be unjustified, although those with relatively brief action are employed in special techniques. Barbiturates in conjunction with inhalation anæsthesia are a definite accession to anæsthetic technique. They are now generally administered to induce sound sleep on the night prior to operation to soothe the patient, and remove nervousness and to secure smooth induction and finally to contribute to the action of the anæsthetic itself.

The common barbiturates that are used to produce general anæsthesia are sodium evipan, pentothal and kemithal. The choice of preparation involves chiefly the duration of effects, the toxicity and the personal experience of the anæsthetist with the drug.

Evipan (cyclohexanyl methyl barbiturate of sodium) was introduced especially for intravenous anæsthesia. It acts very quickly and is rapidly broken down in the body. In a good number of cases death has occurred by depression, and it must be used with great discrimination. The chief objection to its use is that it is liable to produce clonic twitching. It may be used with fair safety, however, in a relatively narrow field of analgesia. The action of thio-barbiturates is generally similar, but much shorter.

Thiopentone (pentothal) has largely replaced evipan. This drug is used to produce prompt unconsciousness with rapid recovery so that the depth of anæsthesia may be fairly controlled, an advantage over evipan. But, nevertheless, it is dangerous and should not be used indiscriminately. This drug is not well suited for long operations. Obstetric analgesia has been reported to be fairly good with pentothal; excitement is absent and no harmful effects have been observed in the mother or child.

A new thiobarbiturate "Kemithal" (5-cyclohexanyl-5-allyl-2-thiobarbituric acid) has recently been introduced. It has been given a

fair trial, and the results have so far been very satisfactory. Carrington and Raventos have carried out pharmacological investigations and consider it to be half as potent as thiopentone, and slightly less potent than hexobarbitone; but owing to its lower toxicity kemithal has a wide margin of safety. Equiactive doses of these drugs produce a similar duration of action and onset of anæsthesia. Clinical experience supports the experimental findings.[2] Kemithal has been used as an anæsthetic agent in a number of cases. It has been used for induction before cyclopropane anæsthesia, as the principal anæsthetic agent in combination with nitrous oxide and oxygen; as a sole anæsthetic agent with or without oxygen, and to produce hypnosis in association with regional anæsthesia. The results have been satisfactory—post-operative recovery is rapid and is marked by the absence of complications. This drug has been found to have a particular advantage when anæsthesia has to be prolonged. It is especially indicated in thoracic surgery. In such operations there is usually a diminished vital capacity, and anæsthesia in any form tends to cause further embarrassment. There are many other problems too which the anæsthetist has to face. No real advancement towards the solution of these problems had been made till recently when cyclopropane with oxygen anæsthesia was introduced. But long continued use of cyclopropane has its disadvantages. Trials with thiopentone did not prove satisfactory. Kemithal has recently been used on a number of cases of major thoracic operations, and it has been noted that the drug has distinctly many advantages over other barbiturates. There is no respiratory depression and laryngeal spasms are absent. Recovery is very rapid, and there are no post-anæsthetic complications. This technique is undoubtedly a big step forward in the field of anæsthesia. The use of *d*-turbocurarine chloride along with Kemithal has been very promising.

Attempts to blend the actions of volatile anæsthetics by mixing them have been unsuccessful mainly because the ingredients do not volatilise with equal rapidity. The composition of the inspired anæsthetic is, therefore, quite uncertain. A more rational method of combining the advantages of different anæsthetics is to employ them in sequence. Thus anæsthesia may be induced by the pleasant and promptly acting nitrous oxide and then continued with ether. These may be preceded by a sedative dose of morphine or a full hypnotic dose of a barbiturate, to produce lasal narcosis. This probably presents the nearest approach to an ideal anæsthesia.

Many recent advances have been made regarding administration of general anæsthetics. Most inhalation anæsthetics are given with nitrous-oxide-oxygen-ether apparatus. The flow of the gases is regulated and measured fairly accurately by flow-meter (the Rotameter is the present favourite). The Nuffield Department of Anæsthetics has produced a device, the Oxford vaporiser, which is calibrated to deliver known proportions of ether vapour up to 25 per cent. The ether is kept at a constant temperature over a water-bath. A brief pictorial survey of the evolution of anæsthetic apparatuses by A. Charles King is given in the *British Medical Bulletin* (Vol. 4, No. 2, 1946). This is very instructive and gives a clear idea of the advancement in the technique of administration of various anæsthetics.

Side by side with the advancement of general anæsthesia, there has been a revival of interest in local and regional anæsthesia. Mushin[4] has described the bilateral vagal nerve block at its point of emergence from the skull, for such operations as laryngotomy. For upper abdominal surgery, bilateral intercostal nerve block combined with light general anæsthesia or extradural caudal block has been found especially valuable.

Spinal anæsthesia has been less frequently used during recent years. Nupercaine is the drug of choice, but amethocaine and procaine have also been used.

No reliable statistics of anæsthetic mortality are available. The existing figures give only a rough idea of the relative danger. According to the various compilations, the acute mortality for chloroform is given as 1 in 1,000 to 1 in 5,900, a fair estimate would seem to be 1 in 3,500. This does not take into consideration the delayed deaths. For ether, the figures are 1 in 5,100, to 1 in 23,200—the average would be perhaps 1 in 16,000; for ethyl chloride, 1 in 3,000 to 1 in 7,000; for nitrous oxide in short operations less than 1 in 5,000,000. Beecher (1938) gives 1 in 2,000 for avertin and for chloroform, 1 in 3,500 for cyclopropane, 1 in 5,000 for ether and 1 in 50,000 for nitrous oxide.[5]

With the development of the art and science of anæsthesia operations which were once few in number, have greatly multiplied. At the present day, with our advanced knowledge and experience and constant dependence on the various agents at our disposal, it is difficult to understand how surgical practice could have been conducted without them. Anæsthesia has enabled the surgeon to attack almost every region of the body, and, instead of the operation being hurried over as in the pre-anæsthetic period, the surgeon can now undertake to carry on with deliberation and accuracy. The recent advancement in the field of anæsthesia has been a definite boon to mankind.

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VARIATION OF SURFACE TENSION OF SOLUTIONS WITH TIME*

LORD RAYLEIGH observed that the surface tension of sodium oleate and saponine solutions showed large differences according as whether a static or a dynamic method was employed for the determination. The dynamic (vibrating jet) method measured the tension of a surface hardly a fraction of a second old, whereas the static (capillary rise) method measured the tension of an aged surface. The study of this phenomenon was followed up by a number of investigators later, employing mainly the capillary rise, drop weight and ring methods. The results revealed that the surface tension of solutions of many dyestuffs, proteins, soaps and related substances changed considerably with time. Several theories were put forth to explain the phenomenon. Though in some cases chemical interaction with the atmosphere undoubtedly complicated the phenomenon,[2] it was surmised by many workers that the variation was due to the slowness with which the adsorption film was developed at the surface of solutions.[3]

Experimental Demonstration of Slow Accumulation

An important advance was made by the application of the Langmuir-Adam film balance for the study of this phenomenon by the present author and his collaborators. It was well known that the film balance could give differential values of tensions of the surfaces on the two sides of the float. It was, therefore, convenient to compare the tension of a fresh surface with that of an old one since one of the sides of the float could be kept fresh by sweeping. Further this technique had the advantage that it involved the least disturbance (even the sessile bubble and sessile drop methods would involve large changes in the extent of the interface due to changes in the shape of the bubble or drop) and that the contact angle effects were non-existent. The results obtained[4] with solutions of benzopurpurine 6 B proved to be reproducible. During the course of the study, the existence of a large amount of "impurity" covering a considerable fraction of the total aging surface was noticed. The "impurity" was later identified to be the adsorption film of the dye which behaved like the insoluble monolayers studied by Langmann and Adam. *This novel phenomenon formed the first experimental demonstration of the progressive accumulation of the solute molecules to form the adsorption film.*

The Hypothesis of Activated Accumulation

By assuming plausible values for the area of cross-section of the dye molecule, it was possible to calculate the actual rate of accumulation of the dye at the surface. This observed rate was smaller by several orders than the collision frequency of the dye molecules against the surface. The gas-kinetic equation was used for calculating the collision frequency and the applicability of this equation to solutions was justified by the author on the basis of Wheeler's theory of liquid state.[5] The hypothesis of activated accumulation was put forth to explain the slow accumulation. This hypothesis could also explain the high temperature coefficient of accumulation, exhibition of surface pressure and variation of surface tension with time.

Working with solutions of purified Benzopurpurine 10 B, it was established by crucial experiments and theoretical reasoning that the observed formation of the surface film was not due to (*a*) any change in the bulk accumulation of the solution, (*b*) any reaction with air and (*c*) any insouble impurity from the solution or the atmosphere accumulating at the surface. Moreover, it was shown by sweeping aged and fresh surfaces that the surface got enriched with the dye molecules with time.[6] It was further shown that the hypothesis of Donnan and Barker,[3] (slow diffusion due to the high molecular weight of the solute) was unable to account for the phenomenon; for, to account for the slowness, it would be necessary to assume fabulous values for the diameter of the molecule. The hypothesis of Milner,[7] based on large surface excess was again untenable, since the covering up of even half the available surface took considerable time. The hypothesis of polymerisation[8] would not account for the phenomenon; for, it would need the assumption that (i) the equilibrium between the monomers and polymers should be frozen in bulk, (ii) the rarer species should be adsorbed to a greater extent and (iii) the accumulating species would behave like an insoluble impurity. It was thus obvious that the only comprehensive hypothesis which could account for the slowness of accumulation was the hypothesis of activated accumulation. It had to be noted however that this hypothesis was only a generalised description of conditions at the interface. The exact cause of the activation energy requirements for the accumulation process, was yet to be investigated.

The Electrical Potential Barrier

During a detailed investigation[9] of the time-area curve for the accumulation of benzopurpurine 10 B, it was found that the accumulation slowed down with time much more than could be accounted for, on the basis of the free area available for accumulation. It appeared that electrical repulsion effects might be responsible for the phenomenon. Calculation[10] was made on the assumption that the first lot of dye ions accumulating at the interface form a charged surface which would repel similarly charged ions. A diffuse double layer would thus be formed and would hinder the accumulation of the dye molecules at the surface in the same way. This effect, however, would be considerable almost from the commencement of accumulation if the surface film was gaseous. The only hindrance to accumulation was due to this type of poten-

* Text of Sir Subrahmanya Iyer Endowment Lectures delivered by Dr. K. S. Gururaja Doss, Imperial Institute of Sugar Technology, Cawnpore, on 12th and 13th Dec. 1947, at Presidency College, Madras.

tial barrier; the system would show a tremendously high initial rate of accumulation followed by a very slow accumulation for a considerable length of time. A very similar feature would be exhibited in the variation of surface tension with time as well. Though this hypothesis did not account for the behaviour of benzopurpurine, it accounted very well for the observations made by Adam and Schute[11] with cetyl pyridinium bromide and other solutions. These systems exhibited gaseous surface films which showed a tremendously high initial fall of surface tension slowing down considerably after some time. There appeared to be little doubt that the diffuse electric double layer was the main cause for the behaviour exhibited by the systems studied by Adam and Schute. Another example of this was given by solutions of Nekal Bx.[12] Though the slowness of accumulation observed right from the start with benzopurpurine 10 B cannot be accounted for, on the basis of the electric potential barrier, the latter can explain condensed type) the slowing down of accumulation at later stages.

The Case of Benzopurpurine 10 B and Similar Systems

The activation energy for the accumulation of benzopurpurine 10 B, remained a mystery for a long time. It may appear at first sight that the dye molecule would orient itself so as to put the hydrophobic portions projecting out from water and the hydrophylic groups dipping in water. It occurred to the present author[13] that such an orientation with numerous hydrophilic groups dipping in water would have a high solubilising influence and would render such a molecule unstable at the interface. If, however, one or more of the numerous hydrophilic groups in the dye molecule could be pushed out of water, the solubilising influence would be diminished. These groups may, moreover, help in lateral binding of the accumulated molecules by dipolar or ionic lattice forces. The stabilisation of a molecule of the dye would, therefore, consist in a simultaneous release of the required number of hydrophilic groups from the water surface. While this was a plausible interpretation of the activation requirements for the accumulation process, even a rough calculation of the rate of accumulation would involve the knowledge of the vibration frequency of the water-hydrophilic group bond and the strength of the bond. These data are not available. This difficulty was, however, circumvented by the postulate, that due to the high attraction between the hydrophilic group and the water molecule, the process of detachment of the hydrophilic groups from the water surface takes place by the fissure (not of the hydrophilic group-water bond) of the water-water bond. The stabilisation of a dyemolecule was brought about by a simultaneous release of the water molecules attached to some of the hydrophilic groups (n) present in the dye molecule by a process akin to the evaporation process. On the basis of these postulates, and applying Wheeler's theory, the following results were obtained for a M/4000 solution of Benzopurpurine 10 B:—

n	*Theoretical rate of accumulation. (No. of molecules per sq. cm. per sec.)*
0	10^{22}
1	10^{17}
2	10^{12}
3	10^{7}
4	10^{2}

The experimental rate of accumulation comes out to be $1{\cdot}6 \times 10^{11}$ molecules sq. cm. sec. It appears from this calculation that two of the hydrophilic groups in the dye molecule are projected above the surface of water. Even the approximate correspondence between the theoretical ($n = 2$) and experimental rates of accumulation may be taken to support the postulates made in the calculation. Though it is considered plausible that the two hydrophilic groups may be the amino and the sulphonate, further investigations would be needed to establish this conclusively. In this connection, it is of interest to note that other dyes such as Benzopurpurine 6 B and congorubin[14] which have a similar structure also give similar results. It is of great interest to study the effect of protecting one or more of the hydrophilic groups of the dye in the study of the accumulation process.

Slow Accumulation Due to Slow Diffusion

The investigations on casein[15] and albumin[16] solutions by the trough technique have revealed that the rate of accumulation is nearly of the same order as would be the case if the accumulation occurred by simple Brownian displacements. In these cases, therefore, it may be expected that concentrated solutions should show quick equilibrium. But it is found that the surface tension goes on changing with time for long intervals even with concentrated solutions. This phenomenon is due to (a) time required for orientation of the molecules in the adsorption film (the molecules being huge and complicated in structure would take a long time to get the final orientation which involves often an unfolding of the normal globular molecule so as to project out the hydrophilic groups), and (b) slow and progressive penetration by addition of molecules from below so as to render the film progressively more compact. It is to be pointed out that these two effects may also come into play in the case of benzopurpurine 10 B and in the systems studied by Adam and Schute only at the last stages of the accumulation process.

Conclusion

It is of interest to note that the application of Langmuir-Adam trough for the study of solutions was described by McBain and Wilson[17] independently though a little later than the present author. But. the failure by Adam[18] to obtain results of value may now be seen to be due to the following complications of the systems (such as acetylpyridinium bromide solutions) dealt with by him: (i) The solution gave rise to a gaseous film and made it difficult to measure the rate of accumulation, (ii) the solution was a good detergent and hence wet-

ted the barriers and edges of the trough; owing to this and the highly mobile nature of the gaseous adsorption film, the leakage, past the barriers occurred frequently and produced spurious results and (iii) the detergent being cationic got adsorbed on glass. These complications, however, do not occur with benzopurpurine 10 B. The great possibilities of the trough method have been appreciated by Gongnell as can be seen from his statement[9]: "The most interesting results obtained by McBain and his associates, Doss and Yerehikowsky and Akulinina explicitly point to the fact that this domain of surface chemistry has been unduly neglected and that one may expect to discover many unusual facts and reach surprising conclusions in the process of investigation of ordinary solutions."

The theoretical ideas put forth by the present author have been corroborated by some later workers.[20] Exception has been taken by Alexander[21] who is, however, under the impression that the electrical potential barrier is postulated to explain all cases of variation of surface tension with time. Bnt the comprehensive explanation put forth by the present author which appears to apply to most known cases is the hypothesis of activated accumulation. The electrical potential barrier is a particular case of the above hypothesis and is applicable only to systems such as those employed by Adam and Schute.[11] Alexander's criticism of the electric potential barrier is not valid on account of the following considerations:—

(*a*) Alexander has stated that the electrical potential barrier does not explain the elimination of the time effect at the water-oil interface. It is to be noted, however, that very few water-oil systems have been investigated so far. There are some water-oil systems in which the interfacial tension does vary with time.[22] If such systems are investigated in detail, the role of the oil in the elimination of the time effect may become clear. Alexander's idea that the presence of non-polar molecules at the surface increases the rate of accumulation is not always true, since an opposite result is obtained when amyl alcohol is added to benzopurpurine 10 B solutions.[23]

(*b*) Alexander has discussed the effect of monolayers on the rate of accumulation. But the data he has cited in this connection are too complicated to be of much use in testing the hypothesis. Alexander has not taken into consideration in his discussion the following factors: (*a*) the removal of the potential barrier, (*b*) the removal of the molecules of the monolayer by peptisation (peptising action is due to the amphipathic solute), (*c*) the nature of the interaction between the solute and the monolayer molecules and its effect on the rate of escape of the adsorbed solute into the solution, and (*d*) the contraction of the surface during the spreading of the piston oil. The conclusion of Alexander that "the use of suitable piston oil monolayers might be made the basis of a more general method for obtaining the final surface tension of solutions of ionised compounds", cannot be taken for granted.

(*c*) Alexander has further pointed out that the electrical potential barrier cannot explain the behaviour of hydrocinnamic acid solution in water or of lauryl sulphonic acid in isobutylene. But, in these cases, a different type of potential barrier is in existence. Obviously, the electrical influences are negligible.

(*d*) Alexander tries to compute the possible magnitude of the potential barrier by examining the reaction between ethyl palmitate monolayer and N. NaOH. He concludes that a factor of 4, and not much more, can be accounted for by the electrical repulsion. It is to be pointed out, however, that Alexander's procedure is not accurate since he has generalised the results obtained from a solution at high ionic strength (normal alkali) to all solutions. Any solution containing electrolytes to the extent of 1 N cannot be expected to exhibit large electrical repulsion effects. No data of the type examined by Alexander with solutions of low ionic strength are however, available.

(*e*) Alexander postulates that penetration and reorientation explains all the observed results. The author does not take exception to these ideas, though it may be pointed out that many of the cases examined so far exhibit activated accumulation and a few of them are associated with an electrical potential barrier. Alexander's assumptions that penetration and orinetation are favoured by a hydrocarbon environment is not true as a general effect since amyl alcohol actually slows down the rate of accumulation of benzopurpurine 10 B.[23] His idea that "Na hexadecyl sulphate is adsorbed some ten times more slowly than the dodecyl compound" is not correct. To obtain a surface tension of 50 dynes/cm., it takes 5 minutes for the hexadecyl compound and 25 minutes for the dodecyl compound. Whereas this is difficult to understand on the basis of reorientation, the electrical potential barrier gives a simple explanation.

(*f*) We may further point out that the penetration idea of Alexander cannot apply to the initial stages of accumulation of benzopurpurine 10 B at all, since the accumulation is slow *right from* the start.[19,23] The high temperature coefficient of the rate of accumulation is again incompatible with any simple penetration idea and is in support of the activation hypothesis.[23]

(*g*) Alexander next goes on to explain the quick attainment of equilibrium in solutions known to contain micelles. He takes the anology from the spreading of oleic acid on a surface covered by a piston oil and suggests that the rapidity of accumulation may be due to a similar spreading of the micelles at the surface. It is to be pointed out, however, that even if the above mechanism be accepted, the rate of covering up of the surface by the adsorption film is lowered by micelle formation since the number of micelles per unit volume for any given concentration of the solute is inversely proportional to the number of simple molecules present in each polymer and the rate of diffusion of the polymer is smaller than that of the simple molecule. If only classical infusion comes into effect, micelle formation

should *bring down* the rate of accumulation. So, Alexander's interpretation of this fact is incorrect.

(*h*) Though an exact molecular kinetic interpretation of the effect of micelle formation of the rate of accumulation is beset with difficulties, general considerations, show that micelle formation should be associated with quick accumulation. It is to be pointed out that micelle formation is due to inter-molecular attractive forces, and it is hindered by inter-ionic repulsion. Inter-ionic repulsion between like ions is also the cause of the electrical potential barrier. Any factor which brings down the inter-ionic repulsion (*e.g.*, addition of salts, increase of the concentration of the paraffin-chain salt) favours micelle formation and at the same time favours quick accumulation at interfaces. Thus the accelerating effect of salts is not due to micelle formation though the latter may take place incidentally. The increase in the rate of accumulation at higher temperatures (though the micelles themselves tend to break down at higher temperatures) is again a point against considering micelle formation as being the cause of quick accumulation.

(*k*) It may be finally pointed out that the penetration and orientation effects are also likely to consist of steps requiring energy of activation.

Thus the application of the film balance to the study of solutions has given a new and powerful tool in the hands of the physical chemist. The study has already led to a comprehensive hypothesis for explaining the aging of surface and an extensive investigation in this field is further likely to be valuable in elucidating the several obscure phenomena associated with the surfaces of solutions of capillary active substances.

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DETAILS ABOUT ICE-AGE MAN

THE fossil remains of the 15,000-year-old Tepexpan man are being reassembled at the Smithsonian Institute in U.S.A.

Study thus far shows that this gentleman of the ice age was taller than his modern-day descendants. He is believed to have been about five feet eight inches in height—"well above the average stature of modern Mexican Indians".

The Tepexpan man, believed to be the oldest fossil human being, was dug up last February from an ice-age swamp near the village of Tepexpan, which is not far from Mexico City.

The remains—parts of a skull, jaw bones, arms, legs and a few other odd skeletal pieces—were flown to U.S.A. late in June. They are being reassembled by Dr. Stewart and Dr. Javier Romero of the Mexican National Museum of Anthropology.

Dr. Stewart emphasised that no final conclusions can be drawn since only one Tepexpan man has been found—and he may have towered above his compatriots. He hopes another of his kind will be found to shed further light on this angle.

The Tepexpan's teeth were also interesting. Although worn down badly, there are no signs of dental cavities or tooth decay and many of his teeth were missing.

His brain appears to have been "about normal" for the modern Indian. His intelligence is also said to have been about the same.

According to the sutures of the skull Tepexpan was in his forties when he met death. It is assumed that he met an unhappy end, since his remains were found face down on what was once the edge of a lake. He may have been killed. but there is nothing now to account for his death.

As for Tepexpan's missing backbone, ribs, shoulder blades and pelvis, they evidently were either destroyed by animals or disintegrated through the years.

CONFERENCE ON CULTURE COLLECTIONS OF MICRO-ORGANISMS IN LONDON

A SPECIALISTS' Conference on Culture Collections of micro-organisms was held at the London School of Hygiene and Tropical Medicine between August 5th and 8th, 1947, and was attended by delegates from the United Kingdom, Australia, Canada, Eire, New Zealand, South Africa and the British Colonies. Suitable delegates from India were not able to be present, and it is with the object of informing Indian microbiologists of the recommendations made by the Conference that this article has been written.

The establishment of the "British Commonwealth Collections of Micro-organisms" was recommended as the first step to co-ordinate the activities of existing culture collection and to encourage the formation of new ones. A permanent committee is to be formed with its secretariat in London; each Dominion will be represented on the Committee, and overseas members will, where necessary, appoint deputies resident in England to attend meetings of the Committee.

National Committees are to be set up in each Dominion to carry out within their own countries the same co-ordinating work that the Permanent Committee does for the Commonwealth as a whole. It is desirable that members of these Committees should be scientists responsible for the day-to-day administration of the collections since many of the problems to be worked out will be technical. National or regional collections should be maintained and, where necessary, new ones developed to fulfil new needs. Collections may be required to supply organisms for one or more of the following purposes: teaching, both academic and applied research, and industrial processes. The Conference discussed at some length the advisability of having separate collections to serve different interests (agriculture, medicine, industry) but it was finally agreed that such a division was not desirable and that wherever possible a taxonomic classification should be used for separating the activities of collections so that one collection will maintain bacteria, another fungi, a third algæ, and so on. This will have the advantage that workers in a collection need be trained only in one branch of microbiology, and in this branch they will become more expert than workers who have to deal with several branches.

Culture collections should not be an end in themselves, they should be the means to an end. They constitute a wealth of material for research of all kinds; therefore the qualified staff should consist essentially of research workers enlisted for their drive and ability rather than their knowledge of taxonomic relationships which they will pick up quickly when working in a collection. Collections should be centred at research or teaching institutes and the widest possible contacts should be maintained with research workers outside the collections; in this way it may be possible to delegate the maintenance of certain groups of organisms to specilalists so that the cultures sent out will carry the authority of recognised experts.

The National and Permanent Committees will assist collections by distributing technical information, especially that relating to the preservation of micro-organisms.

The compilation of catalogues of different collections will be encouraged by the National Committee and, with the object of preparing a Commonwealth Catalogue in loose-leaf form, a uniform page-size is to be adopted (the actual size will be decided by the Permanent Committee). Recommendations were made about the details to be included in the catalogue of bacteria and fungi. To make the collections better known to workers a directory of Commonwealth culture collections is to be prepared, and this will give information about the kind of micro-organisms maintained in each collection.

When a culture is sent to a collection it should be accompanied by a detailed description and a reprint of any published work on it. Acceptance of a culture is left to the discretion of the curator who will see that the culture received conforms to the description sent. If the donor is not sufficiently interested to prepare an adequate description it is unlikely that the organisms will be of value to a collection.

The framework of the British Commonwealth Collections of Micro-organisms Organisation is sufficiently flexible to allow changes to be made as they may be needed. What the Conference did was to provide a nucleus; it is up to the Permanent and National Committees, supported by the collections. to develop the plan; by hard work and active co-operation it can be made the greatest Collection of Collctions.

ATMOSPHERE ON MARS

HARVARD Observatory has announced that the first definite clue to the composition of Mars' atmosphere has been uncovered.

The amount of carbon dioxide is similar or greater than that found on earth, it was disclosed in a report from Director C. P. Kuiper of McDonald Observatory.

"It is quite a very important result," said Doctor Fred Whipple, Harvard Professor of Astronomy, "it means that, at last, we have some definite identification of the Martian atmosphere. All we knew before was that the atmosphere on Mars contained a small amount of moisture."

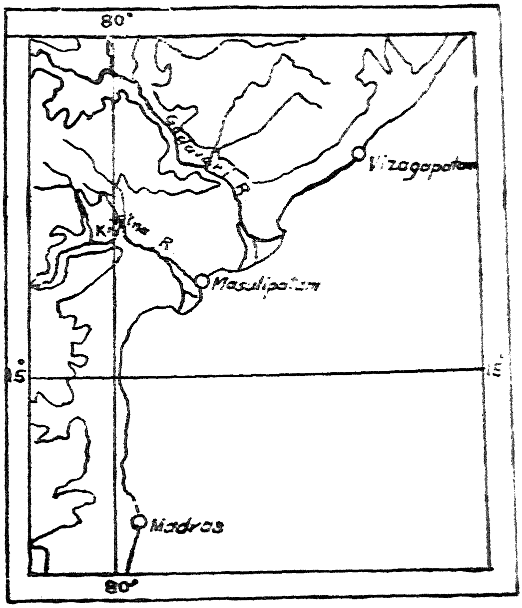
The discovery was made possible by the war-time development of an infra-red photocell, a sort of superscope. With this device, Kuiper reported that an infra-red spectrum of Mars was recorded at McDonald Observatory and the carbon dioxide "found to be present in an amount similar to that on earth". Because of the pressure effects on the band intensity, he said, the carbon dioxide content of Mars' atmosphere will actually be somewhat larger than that of the earth, if the total pressure on Mars is less than on earth, as is [illegible]"

LETTERS TO THE EDITOR

LOWER LEVEL WINDS ALONG THE DELTAS OF THE NORTH MADRAS COAST IN THE MONSOON

WHEN the pilot balloon observatory was started at Masulipatam in 1942, it filled a gap between the observations at Madras and at Vizagpatam on the east coast of India. Soon after, it was noticed that the actual wind speed at lower levels of 0·5 and 1·0 km. at Masulipatam was much greater than at corresponding levels either at Madras or Vizagpatam. An application of the equation of continuity was attempted. The weather along the north Madras coast is free from precipitation except when a monsoon 'pulse' is passing over the place. At other times the upward velocity can be assumed to be negligible: Only the horizontal velocities need be considered. The modifications in the latter can only be due to orography (see figure).

Masulipatam is on the northern side of the Krishna delta and within 30 miles of the southern stream of the Godavari delta. The two deltas almost overlap. Taking account of the 1000 ft. contour, the Godavari valley is almost N.W. to S.E.; and the Krishna valley (north of the Nallamalai Hills) is almost W. to E. At a station situated on the overlapping portion of the deltas of Godavari and Krishna, the winds flowing down the two valleys must blow together or coalesce. The directive effect of the orography persists up to twice or thrice the height of the valley from the sea level (or up to about 3,000 ft. or 1·0 km. above sea level). Above this height, there would be very little influence.



The west to east stream in the monsoon on the north Coromandel coast is the monsoon air mixed with other air while the northwesterly is

the dry continental air that goes to form the monsoon depressions. The latter air is well pronounced over the more extreme portions of the north Madras coast. The nearest pilot balloon observatory which can give the values of the W. to E. stream south of Masulipatam is Madras. The nearest observatory north of Masulipatam giving an idea of N.W. to S.E. stream is Vizagpatam. The distance between these latter observatories is great from Masulipatam. The values of wind speed and direction can only be approximations to those flowing along the valleys. The following table gives the average wind for the months of July and August for the three years 1942-45.

TABLE

Average Upper Winds in Mid-Monsoon

Height above	Madras		Vizagapatam		Masulipatam		Madras + Vizag	
M.S.L.	D	V	D	V	D	V	D	V
0·5 km. ..	265	6·1	250	7·0	270	12·0	260	12·9
1·0 km. ..	275	7·3	270	7·2	280	12·9	270	14·4
1·5 km. ..	280	9·1	285	8·9	285	12·3	285	18·2
2·0 km. ..	280	10·6	285	9·8	285	11·8	285	20·5

D is the direction to the nearest 5°, and V speed (metres/sec.). The addition of wind velocity is vectorial.

It is seen that the algebraic sum of winds at Madras and at Vizagpatam are nearly of the same order but greater than at Masulipatam at 0·5 and 1·0 kms. At higher levels there is little comparison. It is surprising that such a good fit at the lower levels could be found considering the various uncertainties that enter meteorological quantities. If the winds at Masulipatam had exceeded the algebraic sum of the winds at Madras and at Vizagpatam at lower levels, the idea of applying the equation of continuity would necessarily have been open to question. It is not often that such simple applications are met with in weather.

During the other months, when the winds do not blow along the valleys of the rivers, *e.g.*, in the N.E. monsoon, there is no abnormality in the winds at Masulipatam.

Poona 5, S. L. MALURKAR.
November 19, 1947.

THE ESTIMATION OF THALLIUM

NUMEROUS volumetric methods have been proposed, which makes use of the reaction $Tl^{+} \rightarrow Tl^{+++}$. Most of the common oxidising agents have been tried and reported to yield useful results: Potassium permanganate,[1] Potassium bromate[2] and Ceric sulphate.[3] While a considerable saving in time may be effected, these cannot be regarded as very satisfactory; for, the normal potential of the $Tl^{+} \rightleftarrows Tl^{+++}$ system is about + 1·2 v., and an indicator which will function under these conditions is hard to find. The use of irreversible indicators like methyl orange sometimes leads to faulty end-points, or one has to take recourse to complicated potentiometric methods. A rapid gravimetric method will, therefore, prove of some interest and the following procedure is believed to serve the purpose.

Procedure.—To the cold thallous solution containing not more than 0·2 gr. of the metal per 50 ml. are added with stirring 20 ml. of a 5 per cent. solution of iodic acid and 10 ml. of alcohol. The heavy white granular precipitate which comes down immediately is allowed to settle for a couple of minutes, filtered through a Jena glass filter of porosity 4, washed preliminarily with a mixture of equal volumes of 1 per cent. iodic acid and alcohol and finally with 50 per cent. alcohol, dried at 105°-110° C. and weighed as $TlIO_3$ factor for thallium = 0·67836.

Results.—A standard solution was made by converting 8·0973 gm. of pure thallium metal into the sulphate and making up the solution to 1 litre. Aliquots of this solution, either directly or on proper dilution, were pipetted out, for each determination. Simultaneously, estimations of thallium were carried out employing the chromate method of Moser and Brukl.[4] The measuring flasks and pipettes used were those tested and certified by the National Physical Laboratory as conforming to A grade accuracy; these were further calibrated in this laboratory. Some of the results are detailed below.

Thallium taken (gm.)	Amount found in estimation as iodate (gm.)			Amount found in estimation as chromate (gm.)
	Minimum	Maximum	Average*	
0·2024	0·2004	0·2038	0·2020	0·2017
0·1619	0·1610	0·1620	0·1615	0·1618
0·0506	0·0498	0·0508	0·0503	0·0507
0·3239	0·3230	0·3241	0·3238	0·3236
0·4049	0·4041	0·4052	0·4048	..

* Represents the average of 5 estimations.

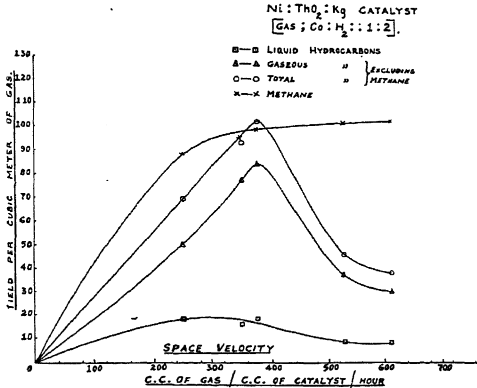
It will be noticed that at lower concentrations of the thallous ion the iodate values are slightly lower. This possibly arises from a slight solubility of the iodate precipitate. According to LaMer and Goldman[5] the solubility of thallous iodate in water at 25° C. is about 0·7 gm. per litre, but under the above conditions of precipitation, the salt is almost insoluble. Further study of this aspect of the problem is in progress.

Andhra University,
Waltair, BH. S. V. RAGHAVA RAO.
October 28, 1947.

1. Beale, Hutchison and Chandler, *Ind. Eng. Chem. Anal. Edn.*, 1941, **13**, 2[illegible]0. 2. Zintl and Reinäcker, *Z. anorg. allgem. Chem.*, 1926, **153**, 276. 3. Willard and Young, *J.A.C.S.*, 1933, **55**, 3[illegible]6[illegible]. 4. Moser and Brukl, *Monatsh.*, 1926, **47**, 667. 5. LaMer and Goldman, *J.A.C.S.*, 1929, **[illegible]1**, 2632.

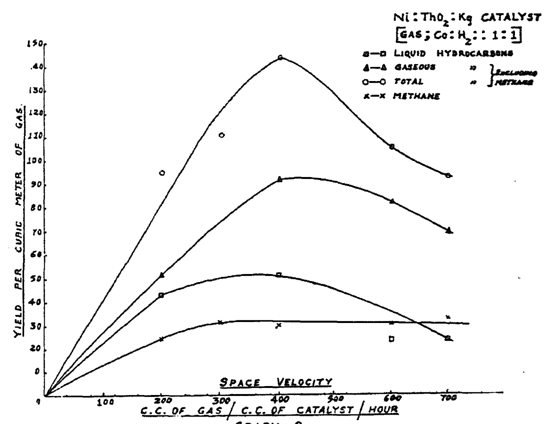
NI-ThO$_2$-KIESELGUHR (100:18:100) CATALYST FOR THE FISCHER-TROPSCH SYNTHESIS AT MEDIUM PRESSURE PART III

IT is well known that there are certain advantages in operating Fischer-Tropsch synthesis at medium pressure. A. J. Underwood[1] and C. C. Hall[2] have shown that the operating pressure (5-15 atms.) has an effect on the yield of hydrocarbons and increases the life of the catalyst. The use of medium pressure enables one to reduce the size of the plant. The medium pressure process is modified by Ruhrchemie, A. G. (1939), using the cobalt catalyst and gives a product containing a high proportion of olefines by using straight water gas.



GRAPH. 1

The present investigation is undertaken to improve the Fischer-Tropsch Synthesis of hydrocarbons economically by using the (1) cheaper catalyst, (2) medium pressure and (3) water gas instead of synthesis gas. The use of cheap Ni-catalyst promoted by Thoria and supported by Kieselguhr at atmospheric pressure has already been reported by Ghosh, Basak and Badami.[3]



GRAPH. 2

The same catalyst has been tried at 70 lbs./sq. inch pressure using synthesis as well as water gas. It is observed that the best reaction takes place at 205° C. in both the cases and the catalyst has been found to be very steady. When synthesis gas is used the yield of methane is found to be very high as shown in the graph. But with water gas the yield of methane goes down and there is a corresponding increase of gaseous and liquid hydrocarbons. The yields of hydrocarbons are plotted against space velocities, using synthesis gas (Graph 1) and using water gas (Graph 2).

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N. G. BASAK.
C. VENKATESAN.

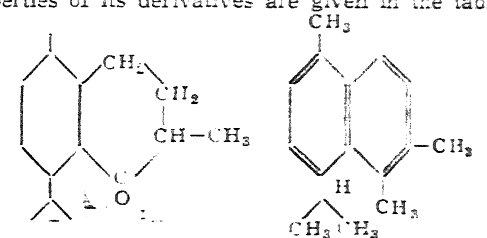
Dept. of Pure & Applied Chemistry,
General Chemistry Section,
Indian Institute of Science,
Bangalore.
November 1, 1947.

1 Underwood, A. J., *Ind. Eng. Chem.*, 1940, **32**, 449.
2. Hall, C. C., *J. of Inst. of Fuel*, 1947, **20**, 65.
3. Ghosh, Basak and Badami, *Curr. Sci.*, 1947, **16**, 318.

STUDIES IN SESQUITERPENES PART II. SYNTHESES OF METHYL CADALENES

IN connection with our investigations on the sesquiterpenes of the cadinene group it became necessary to know the properties of all the possible methyl-cadalenes. In this advance communication we report the syntheses of the 5-methyl-, 8-methyl and 3-methyl-cadalenes. The other two had been prepared previously by Campbell and Soffer.[1]

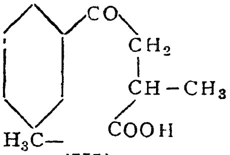
5-*Methyl-cadalene*. 2, 5-Dimethyl-8-isopropyl-tetralone-1 (I) prepared from p-cymene[2] was treated with methyl magnesium iodide to give a mixture of the carbinol and its dehydration product. The mixture was completely dehydrated with 95 per cent. formic acid giving 1, 5, 6-trimethyl-4-isopropyl-7 : 8-dihydronaphthalene. Dehydrogenation of this hydrocarbon with selenium gave the required 1, 5, 6-trimethyl-4-isopropyl naphthalene (II). The properties of its derivatives are given in the table.

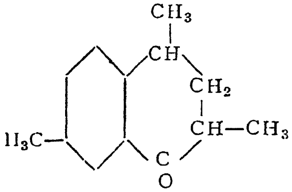


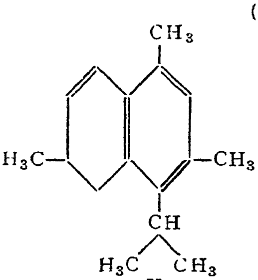
(I) II

3-*Methyl-cadalene*. Toluene was condensed with methyl succinic anhydride in nitrobenzene in the presence of anhydrous aluminium chloride to give β-(*p*-toluyl)-α-methyl-propionic acid (III) (*cf.* Mayer and Stamm).[3] The keto-group of its ester reacted selectively with the magnesium methyl iodide to give γ-(p-*tolyl*)-γ, α-dimethyl-vinyl acetic acid. The unsaturated acid was reduced with hydro-iodic acid and red phosphorus to give γ-(p-tolyl)-γ, α-di-

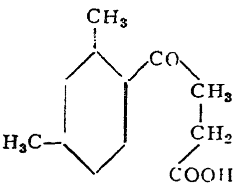
methyl-butyric acid. This acid was cyclised by anhydrous aluminium chloride and the tetralone (IV) so obtained reacted with magnesium iso-propyl bromide to yield the unstable carbinol. The alcohol on dehydration followed by de-hydrogenation with selenium furnished 1, 3, 6-trimethyl-4-isopropyl-naphthalene (V). The melting points of its derivatives are recorded in the table.

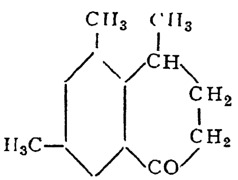

(III)

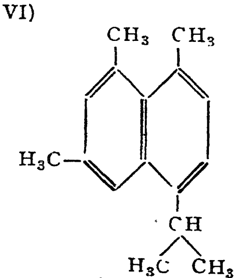

(IV)


V

8-*Methyl-cadalene.* β-(2, *m*-xylol)-propionic acid (VI)[4] was prepared by the action of succinic anhydride on *m*-xylene in the presence of anhydrous aluminium chloride. Its methyl ester on treatment with magnesium methyl iodide gave γ-(2-*m*-xylyl)-γ-methyl-vinyl-acetic acid which was reduced to the corresponding butyric acid with hydro-iodic acid and red phosphorus. The acid on ring closure yielded the 4, 5, 7-trimethyl-tetralone-1 (VII). The ketone was treated with magnesium isopropyl bromide, when an unstable cabinol was obtained; the latter was dehydrated with 90 per cent. formic acid and then dehydrogenated with sulphur to give the 8-methyl cadalene (VIII). The melting points of its derivatives are given in the table.


(VI)


(VII)


(VIII)

Hydro-carbon	Picrate m.p.	Styphnate m.p.	T.N.B. compound m.p.	T.N.T. compound m.p.
3-Methyl-cadalene	162–3°	..	165°	..
5 Methyl-cadalene	102·5–103·5°	130–1°	160–1°	87–8°
8-Methyl-cadalene	108–108·5°	..	118–118·5°	..

The full paper on the subject will be published elsewhere.

My thanks are due to Prof. P. C. Guha for his kind interest in the above investigation.

Organic Chemistry Laboratories,
Dept. of Pure and Applied Chemistry,
Indian Institute of Science,
Bangalore, SUKH DEV.
November 4, 1947.

1. Campbell and Soffer *J. Amer. Chem. Soc.*, 1942, **64**, 417. 2. Sukh Dev and Guha. *Science and Culture*, 1947, **13** 73. 3. Mayer and Stamm, *Ber.*, 1923, **56**, 1424. 4. *Cf.* Barnett and Sanders, *J.C.S.*, 1933, **7**, 434.

RHODAMINE 6 G.–A NEW INDICATOR IN OXIDIMETRIC TITRATIONS

RHODAMINE 6 G, a valuable adsorption indicator, in argentometric titrations of the bromide, may be employed in oxidimetry as well. Its strongly fluorescent aqueous solution retains this property in dilute mineral acids (4 N), and is oxidised irreversibly by potassium permanganate, and reversibly by ceric sulphate to an orange colour with simultaneous extinction of fluorescence. The change is very sharp. This substance is, therefore, used as a reversible indicator in titrations with ceric sulphate. Employing a 0·05 N solution of ceric sulphate in 1·5 N sulphuric acid and a few drops of a 0·1 per cent. solution of the indicator, the following substances have been successfully estimated in both hydrochloric and sulphuric acid solutions :—Ferrous sulphate, stannous chloride, potassium ferrocyanide and hydrogen peroxide. Although the end point is sharp enough in stronger solutions up to 4 N acid content, for the best results, it is recommended that the overall acidity on completing the titration may not exceed 2 N.

The indicator has been found, however, to be unsuitable in the titration with ceric sulphate of oxalic acid, arsenious and antimonius acids, with or without an iodine monochloride catalyst. In the first two instances the indicator is rapidly destroyed, while in the case of antimonious acid, the formation of pentavalent antimony turns the indicator pink which undergoes no further change in colour even with a large excess of the oxidising agent. The subject is under further investigation. The indicator cannot be used in the presence of a precipitate or mercuric chloride.

It has further been observed that ferrous iron may be conveniently titrated with ceric

sulphate in the presence of oxalic acid or arsenious acid using this indicator. It would be interesting to recall the observations of Pound[1] who arrived at similar conclusions regarding the effect of various reducing acids on the titration of ferrous sulphate using a different method of indication. Fuller details will appear elsewhere.

Andhra University,
Waltair,
November 14, 1947.

BH. S. V. RAGHAVA RAO.

1. Pound, *Chem. Eng. and Min. Rev.*, 1940, **32**, 418.

PREPARATION OF ETHOXY ACETONITRILE

JUST like methoxy acetonitrile the ethoxy compound is very useful for the synthesis of aromatic ketones. Several procedures[1] have been used for its preparation. The more important of these are the following:—

1. $Cl.\,CH_2.COOH \rightarrow EtO.\,CH_2.COOH \rightarrow EtO.\,CH_2\,COOR \rightarrow EtO.CH_2.CONH_2 \rightarrow EtO.CH_2.CN.$
2. $Cl.\,CH_2.COCl \rightarrow Cl.CH_2.CONH_2 \rightarrow Cl.CH_2.CN \rightarrow EtO.CH_2.CN.$

They involve a number of steps and the preparation, therefore, takes time and is also expensive. Method I was adopted during wartime in this laboratory[3] when simpler alternatives could not be explored. Experiments have now been conducted for preparing this useful reagent by the simpler and quicker procedure commonly adopted for preparing the analogous methoxy compound[2] using diethyl sulphate instead of dimethyl sulphate.

$$HCHO + HCN \rightarrow HO{\cdot}CH_2.CN \xrightarrow{Et)_2SO_4} EtO.CH_2.CN.$$

It is found that the reaction is considerably slower and the conditions have consequently to be modified in order to obtain the best yields. The following are the full details.

Powdered potassium cyanide (26 g.) was dissolved in water (75 c.c.) and the solution cooled to $-5°$ C. in freezing mixture. Formalin (40 per cent., 35 c.c.) diluted with water (35 c.c.) was then added little by little with shaking. The temperature was not allowed to rise over 0° C. throughout this procedure. The mixture was left in the ice-bath for an hour with occasional stirring. Diethyl sulphate (55 c.c.) previously washed with ice-cold water was added all in one lot to the cold solution of formaldehyde cyanhydrin. The mixture was vigorously stirred with an electrical stirrer. As there was no visible reaction in the cold, the mixture was slowly heated to 45° in a water-bath. The heavy layer of diethyl sulphate at the bottom disappeared in about ten minutes and a lighter layer of ethoxy-aceto-nitrile appeared at the top. It was rapidly separated and diluted with anhydrous ether. Some more water separated out and was removed. The ether solution was then dried over anhydrous sodium sulphate. After evaporating the ether, the residue was distilled under reduced pressure (15 mm.) and the fraction distilling below 80° C. was collected. The yield was 6-7 c.c., and the product was pure enough for use in the Hoesch condensation directly. With phloroglucinol it gave a good yield of ω-ethoxyphloracetophenone, and the ketone was identical with the sample already described.[3] The nitrile could, however, be distilled again at atmospheric pressure and collected between 133° and 138° C.

Our thanks are due to Prof. T. R. Seshadri for his interest in this work.

L. RAMACHANDRA ROW.
T. R. THIRUVENGADAM.
Dept. of Gen. Chemistry,
Andhra University,
Waltair,
November 30, 1947.

1. Sommelet, *Ann. Chim. Phys.* 1906, **9**, 493. 2. *Organic Synthesis*, **13**, 56. 3. Row and Seshadri, *Proc. Ind. Acad. Sci.*, A, 1946, **23**, 140.

BACTERIAL SYMBIOSIS IN A *MARGARODES* SP.

To avoid confusion it may be mentioned that the Polish Cochenille insect, *Margarodes polonicus* L., has a red dye, as in the lac insect, and its symbiosis was being studied by Prof. Jakobski of Poland. Another speceis, feeding on grass roots, has been discovered by Sulc, at Brünn, and is evidently new to science. It is blue coloured, resembling unripe bilberries but free from any dye within its body.

When a mature specimen of Sulc's Margarodes is dissected each ovary is found to contain a tumour-like growth which is carmine coloured and therefore conspicuous. This tumour has been called mycetome, but should now be designated bacteriotome. It has been illustrated by Sulc[1] and further mentioned by Buchner[2] in more than one treatise, as it would appear to represent a type of bacteriotome by itself. I had good opportunities of studying Sulc's Margarodes. In full-grown individuals the two ovaries have each a bacteriotome; but in immature insects the ovaries are connected by a bridge-like tumour with a constriction in the middle. This central narrow portion indicates that the bacteriotome subsequently separates into two exactly as Sulc has illustrated them.

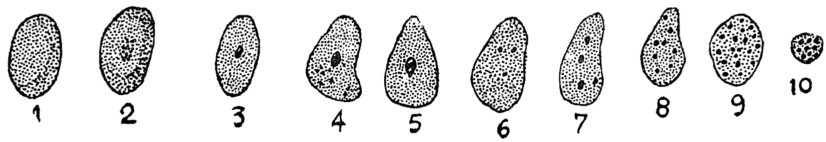
Smears from the tumours belonging to immature insects were stained with Giemsa, the symbiotes proved to be delicate bacteria which have evidently escaped Sulc's observation. Even in thin sections, which are usually 5 μ thick, the granule-like bacteria would not be clearly seen. The technique of making a smear —a technique not employed by Sulc—enables the identity of the bacteria. The symbiotic bacterium was successfully cultivated a number of times. The smears from cultures always compared well with those from the bacteriotomes.

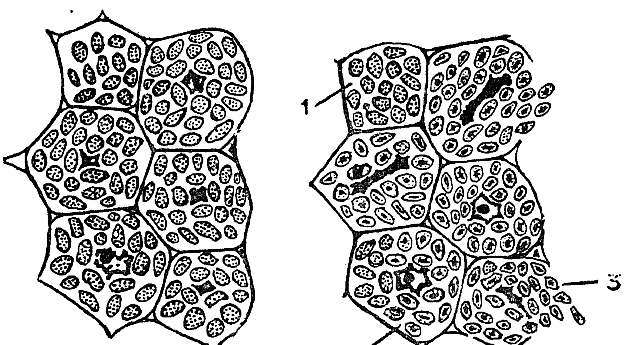
Even apart from the fact that Sulc[1] has overlooked the existence of the bacterium, his interpretation of the symbiote as an yeast involves some confusion. On p. 16. Fig. 9 (1), he gives a section of the tumour attached to the ovary; a portion of this illustration is offered as Fig. A here with six tumour cells. Their cell inclusions are apparently some kind of yeasts. For this reason Buchner[2] calls the tumour in the Margarodes sp. a "Pilzorgan", although Sulc

himself is more diffident and designates the cell contents merely as symbiotes. In Sulc's[1] Fig. 9 (2), which is illustrated in part as Fig. B here, he gives the picture of the tumour in a more advanced stage. In Fig. B (tumour cell No. 1) the yeasts are identical with those seen in Fig. A ; in both, the germs are immature. In Fig. B (tumour cell No. 2) some yeasts are immature while the rest are nucleated. The yeasts in Fig. B are relatively more developed—particularly those seen as cell inclusions in tumour cell No. 3 are fully mature and on their way to infect future eggs. To a critical observer Figs. A and B would strike as similar. They would hardly appear to have been drawn from a histological section or with a camera lucida and are more or less diagrammatic in representation. Such an idealisation appears to have been applied also to the detailed study of the symbiote whose yeast-like nature he proposed to establish.

On p. 17 in Figs. 1 to 10, Sulc[1] gives the life-cycle of the symbiote. His illustrations are reproduced with his numerical indications. Fig. 1 is the youngest stage, then comes Fig. 2 and thirdly No. 3 ; all these forms are seen while the yeasts are in the tumour cell. The development occurs mainly in the formation of a nucleus-like central body which has been merely illustrated without any explanation. The symbiote, when it leaves the tumour, enters the lumen of the oviduct and shows more and more clearly the chromatin body as in Figs. 4 and 5. By the time it reaches the follicle it shows the development represented in Figs. 6 to 9. The yeast, finally ready for infecting the egg, is reduced in size but is rich in chromatin bodies resembling chromosomes, being the stage shown in Fig. 10—the end of a mysterious life-cycle of an unknown germ.

Nolte[3] has carefully studied symbiosis in the beetle, *Erythrapin miniatum*. The symbiote is a bacterium, but with a complicated life-cycle, as in many other cases of symbiotes which have been studied only in sections and never in cultures. What is interesting is to find in Nolte's Fig. 12, m., an identical stage with that of Sulc's Fig. 10 (10), or Fig. 10 here, although Nolte considers his germ a bacterium and Sulc, an yeast. In representing such life-cycles, white blood cells of insects, secretion granules and bacterial metabolic products have been confused ; and the results, although based on correct observations, have to be very critically interpreted. For these reasons, a physiological test, like the production of a pigment *in vitro* by the culture of the symbiotic germ, conclusively proves the correct isolation of the symbiote. Neither the insect nor the symbiote produces any colour and hence the only finding that has to be emphasised is the existence of a bacterium in the smears from Sulc's Margarodes.





A B

The work was undertaken, at Brünn, in the Laboratory of Prof. Sulc, to whom it is a pleasant duty to thank here again.

Dept. of Biochemistry,
Cipla Laboratories,
Belassis Road,
Bombay,
S. Mahdihassan.
November 15, 1947.

1. Sulc, *Pub. biol. Ecole. Haut. Etud. veter.*, Brünn, 1923, **12**, 16. 2. Buchner, *Erg. d. Biol.*, 1928, **4**, 73. 3. Nolte, *Zeit. f. Morph. u. Okol.*, 1937, **33**, 179.

RATE OF GROWTH OF DIPLOID AND TETRAPLOID YEASTS

The effect of duplication of chromosomes has been known to result in a change in the norm of reaction. In higher plants investigations show that the geographical distribution of the autotetraploids differ in many cases from those of the diploids. In fact, autotetraploids have been known from localities which are considered unfavourable to the diploids.

In yeasts duplication of chromosomes leads to a change in the characteristics of the giant

colonies.[1] Occasional spontaneous tetraploids could be seen as smooth sectors in giant colonies of the control (Photo 1, T). Since the surface of the control has folds and striations, it is easy to distinguish between the diploid and the tetraploid. The contour of the sector indicates that its growth is more vigorous than that of the control. It was thought desirable, therefore, to study the structure of a colony developing from an inoculation of a mixture of the control and the tetraploid. Twenty four hour wort cultures of the control, BY 1, and a tetraploid, BY 3,[2,3] were mixed together, well shaken and inoculations were made immediately from this mixed culture. Photograph 2 shows the appearance of the colony after a nine-day growth. It has the typical appearance of the tetraploid colony, indicating that the tetraploid cells have completely eliminated the cells of the control strain by their rapid growth.

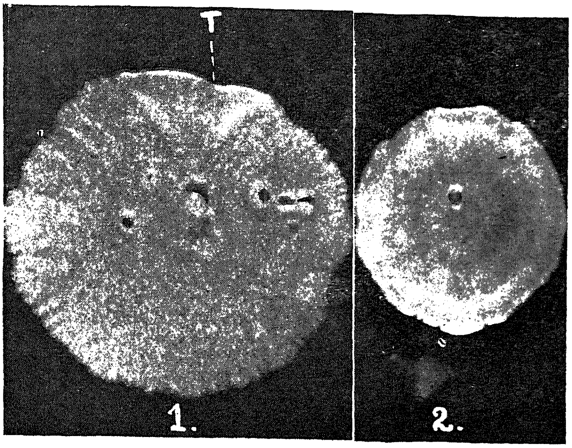
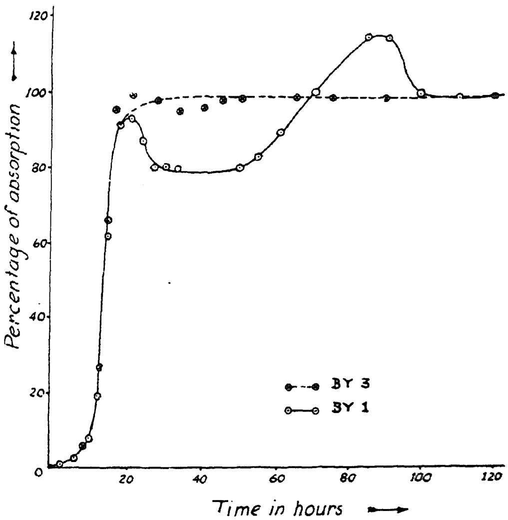


Photo. 1. BY 1. Ten day growth. 2.5 cm. 30-9-1947.
Photo. 2. BY 1 + BY 3. Nine-day growth. 2·2 cm.



Investigations[4] on the nutritional requirements of the diploid, BY 1, and the tetraploid, BY 3, showed no difference. From the data available it could not be judged whether the rate of utilization of the nutrients required for full growth are identical. Since the experiments with giant colonies showed that the rates of growth of the two strains are different, an investigation was carried out on their growth-rates in a standard all-vitamin synthetic medium.[4] The growth of the yeast inoculated into 5 c.c. of medium in 100 c.c. conical flasks, incubated at 26° C., was measured at various intervals using a Lumetron turbidometer.

The diploid strain shows two cycles of growth. The logarithmic growth phase ends in 21 hours after which there is a fall in the curve which is followed by another steep rise indicating the second cycle of growth referred to by Richards.[5] On the other hand, the tetraploid shows a quicker growth-rate and the end of the logarithmic phase is reached in 16 hours. The curve afterwards is parallel to the X-axis and does not show a second cycle of growth.

The difference between the diploid and the tetraploid is thus not limited to the changes in the colony characteristics alone. Duplication of chromosomes seems to affect a number of factors. The similarity of the growth curves of the tetraploid and diploid to that recorded by Richards[6] for the same strain of yeast grown in media with and without colchicine is striking. Without either considering the possibility of polyploidy or a study of the behaviour of the colchicine-treated cells in normal media, Richards claimed not only that colchicine is a food and that it lessens the adverse effects of the increased quantities of toxic waste products released into the medium as a result of growth and fermentation, but also that colchicine fails to reveal mitosis.

From the observations recorded above, it appears that colchicine is neither a food nor is responsible for the disappearance of the second cycle of growth in the case of cultures in media containing the drug. Richards' results, in fact, offer evidence that colchicine has induced polyploidy.

We are very grateful to Sir J. C. Ghosh, KT., D.SC., F.N.I., for his active interest and encouragement, to the Council of Scientific and Industrial Research for generous financial assistance, and to the Council of the National Institute of Sciences (India) for the award to one of us (M. K. S.) of an Imperial Chemical Industries Research Fellowship.

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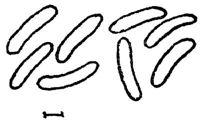
November 17, 1947.

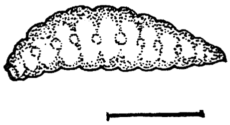
1. Subramaniam, M. K., and R. Ranganathan, *Proc. Nat. Inst. Sci.* (India), (in press). 2. Subramaniam, M. K., *Ibid.* (India), 1946, **12,** 143. 3. —, *Ibid.* (India), 1947, **13,** 129. 4. Prema Bai, Miss M., *Curr. Sci.*, 1947, **16,** 317. 5. Richards, O. W., *Arch. Protist.*, 1932 **78,** 263. 6. Richards, O. W., *J. Bact.*, 1938, **36,** 187.

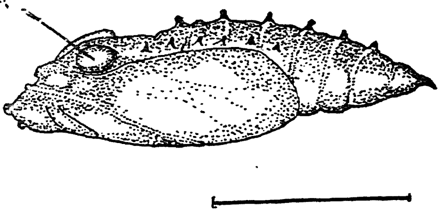
ENDOPARASITIC CHALCID OF *DELIAS EUCHARIS* DRURY

WHILE testing the effect of insecticides on different pests of citrus plants, it was observed that the pupa of *Delias eucharis* Drury, commonly known as Lemon Butterfly, was attacked by an endoparasitic chalcid which keeps down the population of the butterfly. It is mentioned in *Fauna of British India*[1] that "Large number are destroyed by a dipterous parasite very much like a common house-fly". So, it is probable that the life-history of the chalcid under investigation has not been reported so far. With this presumption the life-history of the endoparasitic chalcid is traced in this Laboratory.

The female chalcid introduces the egg into the body of the larva of *Delias eucharis* Drury when the larva is in last instar. In this instar the larva is in a state of inactivity and prepares itself for transformation into the pupa. Several larvæ of the host were dissected to locate the position of the parasitic egg. It was found that the parasitic egg was in the dorsal region just below the body integument in the fatty tissue of one of the two anterior abdominal segments. So far it was found that only one egg is introduced into the body of the host larva. The eggs of the parasite are white in colour, with a thin egg membrane which is somewhat transparent. They are smooth, elongated and slightly curved in the middle as shown in Fig. 1. They measure about 1·3 mm. in length and 0·4 mm. in breadth.







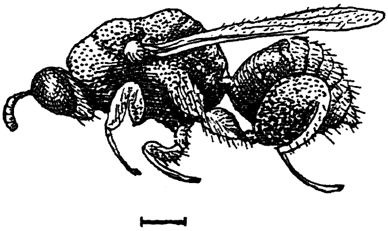


FIG. 1. Chalcid Eggs.
FIG. 2. Chal id Larva.
FIG. 3. Pupa *Delias eucharis*
FIG. 4. Adult Chalcid.

The eggs of the parasite hatch out in 3 or 4 days. The newly hatched larva is white, apodius and measures about 1 m. in length. It has a reduced head which is sunk into the prothorax and thirteen trunk segments. The posterior region of the abdomen gradually tapers towards the tail end as shown in Fig. 2. The parasitic larva is carnivorous in habits and feeds on the organs of the host which are undergoing histolysis and develops rapidly. It was observed that the pupa of the host develops brown patches on the surface as soon as the internal damage is caused. The parasitic larva attains full growth in 5 to 7 days. The cuticle of the mature larva is extremely thin and transparent. The larva measures about 1·2 cm. in length and 0·5 mm. in breadth in the middle. However, the number of ecdysis could not be counted during the growth of the larva.

Pupation of the parasitic larva takes place within the pupa of the host; and at this stage the pupa of the host is empty with some putrefying tissue scattered here and there. The parasitic pupa is of exarate type with no cocoon or case around it. The pupal stage extends to 5 to 7 days.

The adult chalcid comes out of the pupa of the host by making a circular opening, usually in the thoracic region, as shown in Fig. 3 A. The chalcid is a small, black, shining insect measuring about 0·6 mm. The female is slightly larger in size than the male. The head capsule is more or less triangular in shape with two large prominent eyes, surrounded by dense growth of fine white hair. The antennæ are elbowed, and spring a little above the clypeus. The thorax is more chitinous, rough, punctured all over and is densely clothed with fine hair. The abdomen is basally constricted and is attached to the thorax by a slender segment, and is somewhat flattened from side to side. Dense growth of hair is also present on the abdomen but is restricted to the intersegmental regions. The most conspicuous feature is the construction of the legs and its colour. The hind pair of femurs is much enlarged as shown in Fig. 4, and the distal ends of the femur and tibia down the legs are yellow. These chalcids are very active, and they appear in the months of August, September up to the middle of August.

Further work is under progress.

I am thankful to Dr. M. Qureshi, Director, Central Laboratories for Scientific and Industrial Research, for his interest and encouragement.

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Hyderabad (Dn.), MOHANBABU NAIDU.
November 18, 1947.

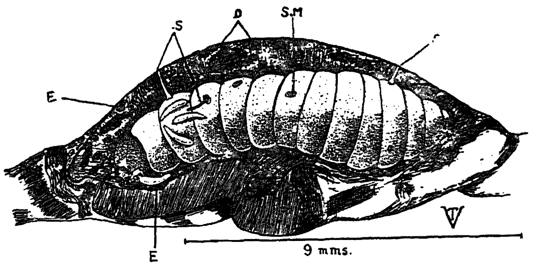
1. *Fauna of British India Butterflies*, 1907, 2, Bingham.

ON THE FUNCTION OF THE "FEEDING TUBES" OF *BRACON* (*MICROBRACON*) *GREENI* ASHM.

Bracon (*Microbracon*) *greeni* Ashm. is a primary monophagous ecto-parasite of the larva of *Eublemma amabilis* Moore (*Noctuidæ*), a predator of major importance on the lac insect *Laccifer lacca* Kerr. (*Coccidæ*).

The female parasite lays her eggs, on or near the host larva lying concealed within its gallery in the lac encrustation, after she has paralysed it by stinging it from 3-6 times with her ovipositor, a process which takes from 5-10 minutes. The neuro-toxin injected takes some time to bring about complete paralysis, and oviposition begins before absolute immobility has been achieved. Paralysis is not always complete, and the host may temporarily retain, or regain some measure of mobility. Occasionally stinging is entirely ineffective.

Prior to oviposition the Braconid usually constructs one or more tubular strands, from the host body to the inert covering, by working her ovipositor slowly upwards and downwards starting from the point of puncture of the host cuticle and ending at the inert covering through which the ovipositor is finally withdrawn; rarely an extension may be seen on the upper surface of the latter. These tubes are formed by a secretion from glands in the abdomen of the female parasite which oozes on to the ovipositor together with a certain quantity of the body fluid of the host. They are glistening, translucent and have a very fine lumen; when first constructed they are tough and somewhat elastic, though they become brittle after 3-4 days. They occur most commonly on the dorso-lateral surface of the thoracic and abdominal segments of the host, and there may be as many as 10, but 1-3 is the normal number; their normal length varies from 0·5 to 5·0 mm., being in fact dependent on the space intervening between host and covering. Incomplete tubes are sometimes found, or tubes may be entirely lacking.



Semi-diagrammatic sectional view of an *Eublemma amabilis* larva, within its larval gallery, parasitised by *B. greeni*; showing ' feeding tube anchoring strands " constructed by the parasite

D. Inert covering of gallery, of webbing, excretal pellets and lac frass.

E. Eggs of *B. greeni.*

S. " Feeding tube anchoring strands".

S. M. Stinging marks left by ovipositor of *B. greeni.*

The construction of such tubes and their use for feeding on host larvæ lying concealed in tunnels or galleries has been described in a number of genera of several families of parasitic Hymenoptera, and is particularly common in the genus *Microbracon*. Genieys[1] has found that feeding on the body of the host is essential for oviposition in *Habrobracon*. Flanders[2] has shown that if insufficient protein has been stored up during larval growth, a protein diet is essential before normal oogenesis can take place in certain parasites, and that the body fluids of their hosts provide a suitable source of protein.

In the laboratory, *B. greeni* females were provided with 2-5 per cent. cane sugar solution for feeding. Feeding tubes were regularly constructed, but in no instance, over many years of laboratory breeding work, was the female *Braconid* ever observed to feed directly or indirectly through them. *B. greeni* clearly does not require a protein diet in the adult stage for normal oogenesis. Even when deprived of sugar solution and provided with water only, these tubes were not exploited for obtaining food, even though both fertility and longevity were impaired in comparison with females not so deprived.

It is suggested that these strands constructed by certain of the parasitic Hymenoptera, have in fact a dual role, serving both as feeding tubes and as anchoring strands. In this latter capacity, they assist in holding the partially paralysed host larva motionless, and prevent it from dislodging the eggs laid on its body, or damaging those laid in the gallery close to it, by movements prior to the onset of complete immobility, and thereafter by involuntary movement due to shaking of the gallery by an external agency such as wind. Their function in this capacity is not long required, for the egg has hatched and the first instar larva has attached itself to the host; it is not easily dislodged. That the strands have sufficient tensile strength for this purpose can be judged by attempting to move a larva so anchored with a needle.

In *B. greeni* the feeding function of these tubes is not exploited, probably due to the fact that sufficient protein is stored up during larval growth and that under natural conditions the nutritional requirements of the adult are met by the readily available "honey dew" excreted by *L. lacca* on which *E. amabilis* is predatory. Further, it appears that the very habit of using these tubes for feeding has been entirely lost in *B. greeni*, even in the absence of other sources of food, and that as a result, the tubes function in their anchoring capacity only.

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October 16, 1947.

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2. Flanders, S. E., *Ibid.*, 1938, **28**, 43.

A *GLOMERELLA* ROT OF *NUNA*

A ROT of fruits of *nuna* (*Anona reticulata*, Linn.) was observed for the first time in an orchard at Rainagar, Sylhet, in December 1944. The disease was quite severe: nearly 15 to 20 per cent. of the fruits were affected. A survey made throughout the district of Sylhet revealed that the rot occurs wherever *nuna* is grown. The disease has also been prevalent in subsequent years causing appreciable loss wherever found.

The rot usually appears during the middle or later part of December. It starts usually but not always from the blossom-end of the fruit; it may start also from any other point. A dirty blackish-brown spot first appears which gradually but very slowly spreads in all directions. The rot is a dry one, and the tissues of the fruit remain quite hard and in tact. The rot advances usually from the bottom upwards until the entire fruit is affected after which it is gradually transformed into a dry shrivelled mass which either remains hanging or falls to the ground. On cutting open a diseased fruit it is found that the substance of the fruit inside has become a black shrivelled mass of tissue, hard to feel and very light in weight. Fig. 1 shows the early symptoms of the disease.

The fungus causing the rot appears on the diseased surface of the fruit as a scanty whitish growth immediately after the onset of the rot. But soon conspicuous pinkish incrustations appear, and the whitish growth becomes almost non-existent. This pinkish growth shows under the microscope innumerable unicellular, hyaline spores. They are straight, often taper slightly at both ends, and measure 10-20 $\times$ 3-6 μ (average 16·2 $\times$ 4·1 μ). After sometime, by the side of the pinkish growth blackish masses of fungal growth are noticed. These show clusters of perithecia containing asci and ascospores. The perithecia are pear-shaped, membranous, dark brown but lighter towards the tip. They are formed on or partly immersed in a loose stroma of light brown, interwoven hyphæ. They measure 220-300 $\times$ 90-210 μ and contain numerous asci without paraphyses. The asci are clavate, sessile, 40-70 $\times$ 7-11 μ, and each contains eight spores. The ascospores are somewhat like the conidia, but are often slightly curved and measure 13-22 $\times$ 4-6 μ (average 19·2 $\times$ 4·8 μ).

A large number of isolations were made. Single spore cultures were taken both from conidia and ascopores. The growth characteristics of the fungus grown on oat agar were studied. The mycelial growth was poor but the fungus produced large ochraceous salmon-coloured spores, and later produced perithecia with asci and ascospores. Cultures from conidia and ascospores manifested identical characteristics, and both formed the imperfect and the perfect spore forms. The morphological characters of the different spore forms agreed with those found in nature and the measurements were the same.

From a study of the morphological characters of the fungus it was found that the measurements of the different spore forms agree with those of *Glomerella cingulata* (Ston.) Spauld. and v. Schrenk, given by Shear and Wood.[1] Hence the fungus under study is identified as *G. cingulata*.

Infection experiments with pure cultures of the fungus on sound fruits in the laboratory and in the field established the pathogenicity in the usual manner.

As the rot is a serious one and causes considerable damage, experiments for its control were carried out during the years 1945 and 1946. It was found that spraying the fruits with 2: 2 : 50 Bordeaux mixture as soon as the rot makes its appearance or just before the time of its usual occurrence completely controls the disease and saves all the unaffected fruits.

So far no fruit rot of *A. reticulata* due to *G. cingulata* has been reported.

Agricultural Laboratory,
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November 1, 1947.

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A PRELIMINARY NOTE ON THE KARYOTYPE IN *CAPSICUM FASTIGIATUM* Bl.

MOST of the varieties of chillies fall under the two well-known species *Capsicum annum* Linn., and *C. frutescens* Linn. A third species, *Capsicum fastigiatum* Bl., with small apogeotropic fruits have been reported from the malnad areas of the Mysore State and in and around Bangalore.[1]

Root tips were raised in pots and fixed in Lewitsky's fixing mixture and stained with Crystal Violet. The somatic count of 24 chro-

mosomes (Fig. 1) accords with the number reported by Raghavan and Venkatasubban[2] for

Fig. 1. X 3600

Fig. 2. X 3600

the South Indian varieties. A study of the morphology of the karyotype has revealed that nine pairs have sub-median constrictions, two pairs, median constrictions, and one pair alone. sub-terminal constrictions. One of the sub-median pairs shows a prominent secondary constriction (Fig. 2).

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November 14, 1947.
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IMPORTANCE OF RESERVE FOOD MATERIALS IN SUCCESSFUL ESTABLISHMENT OF SHOOT CUTTINGS IN *COFFEA ROBUSTA*, L. LINDEN

THE literature on Vegetative Propagation of Coffee is fairly extensive, most of these coming from Java, Kenya, Tanganyika, Peurto Rico, Mysore and, to a less extent, from Sidapur. But there have been few published data wherein stress has been laid on the part played by reserve food material.

The role of carbohydrates in the successful rooting of stem cuttings in plants has been recognised by Goebel,[1] Loeb,[2] Winkler[4] and others. But its importance has gone to the background with the advent of the discovery and study of the natural and synthetic growth-regulating substances.

While tackling the problem of the establishment of Dadap stakes (*Erythrina lithosperma*, Blume) in coffee estates, it was found that cuttings from flowering branches, with high carbohydrate reserves, established themselves better than those from actively growing ones. It was found possible to bring about a similar physiological condition in the growing Dadap branches, by ring-barking them at their base. The idea is similar to that of Reid[3] who showed that ringing in tomatoes raises the C/N ratio in parts above the ring.

The same principle was extended in our work on Robusta coffee. The table below gives the results of two experiments. Single node leafy cuttings from suckers were used. All the primaries were cut off prior to planting. The ringing was done one month before planting.

TABLE

Effect of Ringing on Rooting of Cuttings in R. Coffee

	Planting date	[illegible]	[illegible]	[illegible]
EXPERIMENT I.				
From ringed suckers	5-12-1946	1-4-1947	[illegible]	[illegible]
From un-ringed suckers	5-12-1946	5-4-1947	[illegible]	[illegible]
EXPERIMENT II.				
From ringed suckers	24-6-1947	20-9-1947	[illegible]	27
From un-ringed suckers	24-6-1947	20-9-1947	[illegible]	3

In experiment I, the ring-barking was done at one node only, and not much growth in general was noticed after the date of the operation. This would indicate that the C/N position in both type of cuttings were not widely different. However, in experiment II, the ringing was done during a vigorous growing period and it was done at every internode. This resulted in far greater increase in C/N in the internodes between the rings than the un-ringed parallel cuttings.

The two experiments, though conducted during different parts of the year, demonstrate the importance of the reserve food material in better establishment of Robusta coffee by cuttings. A method has been indicated for obtaining that physiological condition in the planting material. Experiments were conducted in propagating frames in a randomised design. As a frame cannot accommodate more than 100 or 120 Robusta cuttings, further work on a large-scale is planned to be conducted in open nursery beds during the next south-west monsoon period. Details of the work will be published elsewhere.

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K. S. GOPALKRISHNAN.

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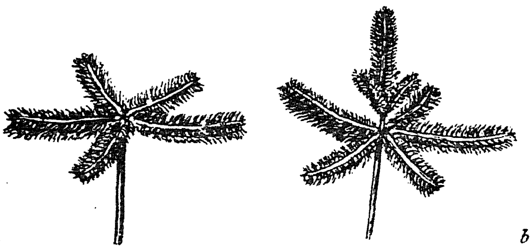
Station, Sidapur P.O.,
Coorg, S. India,
November 28, 1947.

1. Goebel, K., *Bot. Zentbl.*, 1902, **22**, 385, 417, 481. 2. Loeb, *Regeneration*, 1924, McGraw Hill, New York and London. 3. Reid, M. E., *Am. J. Bot.*, 1926, **13**, 548. 4. Winkler, A. J., *Hilgardia*, 1927, **2**, 3.9.

A SHORT NOTE ON A CASE OF DOUBLE-DIGITATE INFLORESCENCE IN *DACTYLOCTENIUM AEGYPTIUM* WILLD.

THE normal inflorescence of *Dactyloctenium œgyptium* Willd. is of digitately radiating spikes in a single whorl (Fig. *a*) the number of spikes varying up to 7 and rarely reduced to a solitary spike. But many plants of this species were observed carrying a second whorl with 1 to 4 spikes, on a short rachis above the first (Fig. *b*), in a field which was heavily



a *b*

Single digitate (of 5 spikes-normal) (*a*)
Double digitate (the 2nd whorl of 3 unequal spikes) (*b*)

manured and had a standing crop of castor. Both the types of inflorescences with single digitate and double digitate spikes were present in one and the same plant in many cases. In a few, thumbs similar to those that are present in *Eleusine coracana* Gaertn., were also observed.

The progenies raised from the seeds of such plants in pots under laboratory conditions failed to exhibit either the freak of a double digitate inflorescence or that with the thumb. It is, therefore, presumed that the environment was responsible for the expression of those characters.

It is interesting to note in this connection that this species, *Dactyloctenium œgyptium*, is very variable in its inflorescence character in that the number of spikes may vary from one in poor alkaline soil to as many as 9, as observed by the authors at Krusadi—an island in the Gulf of Mannar, Ramnad District; the length of the spikes and their width ranged from 0·5 cm. to 4·5 cm. and 0·2 cm. to 0·8 cm. respectively. These are of interest from the ecological point of view.

Madras Herbarium,
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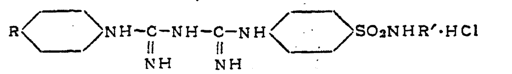
Coimbatore,
November 8, 1947.

STUDIES IN ANTIMALARIALS: SULPHABIGUANIDE DERIVATIVES

IN a previous communication,[1] we have reported some sulphabiguanide derivatives of type A which have a tautomeric biguanide structure combined with well-known sulphonamide derivatives. These compounds have now been tested for their suppressive antimalarial activity against *P. gallinaceum* in chicks and the results have been tabulated below.



... Type A

R = H, Cl, Pr, Me, etc., and R′ = H, 2-thiazolyl and 2-pyrimidyl.

Suppressive antimalarial activity of "Sulphabiguanides"

(P. gallinaceum *in chicks*)

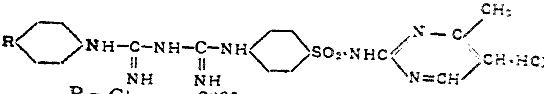
–, not active; +, slightly active; ++, active

No.	R	R′	Dosage in mgs. per 100 gms. body weight	Activity
1	Cl	H	6	–
			12	–
2	CH_3O	H	6	–
			12	–
3	Br	2-thiazolyl	20	–
4	Cl	do	40	–
5	CH_3	do	40	++
6	H	2-pyrimidyl	40	++
7	Cl	do	40	+
8	Br	do	20	–
9	CH_3O	do	20	++
10	NO_2	do	20	–

From the above results, it may be concluded that when the sulphonamido group is unsubstituted the compounds are inactive, while its substitution with pyrimidine ring gives compounds of considerable activity with higher dosages.

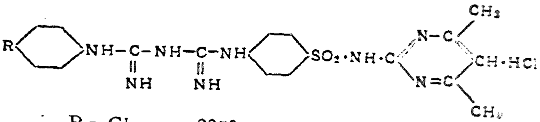
Recently Curd and Rose[2] have put forth an explanation for a possible mode of action of paludrine, wherein the activity is attributed to formation of metallic complexes (Chelate rings) with trace elements *in vivo* and thus depriving the parasite of its mineral requirements. It has been shown that metallic complexes are formed with considerable difficulty in the case of aryl-substituted biguanides,[3,4] and in fact N^1- and N^5-diaryl-substituted biguanides have been shown to be inactive as antimalarials.[4] Compounds of type A are also N^1-N^5 diaryl-substituted biguanides, but their activity, when they are suitably substituted, may show that formation of a metallic complex alone is not responsible for activity and their anti-plasmodial action seems to depend upon the nature of the substituents on either end of a tautomeric biguanide structure.

Sulphamerazine and sulphamethazine are two new alkyl-substituted sulphadiazine derivatives which have shown good antimalarial activity.[5,6] In the light of the present finding it was thought of interest to prepare compounds of type B and C in order to study the effect of alkyl-substituents in the pyrimidine ring as regards their antimalarial activity.



R = Cl; m.p. 238°

Type B



R = Cl; m.p. 225°

Type C

Further derivatives having different substituents in the N^1-aryl nucleus are being prepared. These compounds have been prepared by the interaction of arylcyanoguanidines[1,4] and hydrochloride of sulphamethazine or sulphamerazine in boiling 95 per cent. alcohol. These salts are white amorphous powders and are crystallised from aqueous dioxan. Details of the present work will be published elsewhere.

Our thanks are due to Dr. N. N. De and Dr. K. P. Menon under whose direction the pharmacological testing of the compounds was done. We thank the Indian Research Fund Association for the award of a Fellowship to one of us (H. L. B.) which enabled him to undertake this work.

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Bangalore,
December 5, 1947.

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FINITE PURE FLEXURE

One of the fundamental results in the mathematical theory of elasticity in the Bernoulli-Euler law of pure flexure which says that when a beam is bent by [illegible] moment is pro[illegible] central line [illegible] theory of flexure [illegible] and bending of plates and [illegible] plates it is known that [illegible] of the plate and [illegible] in the plane of bending [illegible] of (b [illegible] the moments [illegible] M_1, M_2 per unit length [illegible] and circular edges are [illegible] ing Poisson's ratio and D [illegible] of the plate. It [illegible] to know what form these [illegible] finite deflections when [illegible]

If a rectangular plate is bent by [illegible] couples into a cylindrical shape [illegible] a and outer radius [illegible] gives the values of the two couples M_1 and M_2 as[1]

$$M_1 = \mu \Big[\tfrac{1}{2}(b^2 - a^2) - \frac{(2-c)(\log b - \log a) [\text{illegible}]}{c [\text{illegible}]} \Big] \quad [\text{illegible}]$$

$$M_2 = -\frac{\lambda}{c} \Big[\tfrac{1}{2}(b^2 - a^2) - \tfrac{1}{2} \frac{2-c}{3-c} (b [\text{illegible}] - a [\text{illegible}]) \frac{[\text{illegible}]}{[\text{illegible}]} \Big] \quad (1.2)$$

where $c = (1-2\sigma)$ [illegible]

If ρ is the curvature of the middle surface, we find, to the second order of [illegible]

$$M_1 = \frac{D}{\rho} \Big[1 - \frac{1}{15}(2 - 6\sigma - \sigma^2) \frac{[\text{illegible}]}{\rho^2} \Big] \quad (2.1)$$

$$M_2 = -\frac{\sigma D}{\rho} \Big[1 - \frac{1}{60}(3 - 7\sigma)(1-\sigma) \frac{[\text{illegible}]}{[\text{illegible}]} \Big] \quad (2.2)$$

which show that M_1 can be greater or less than D/ρ but $|M_2|$ is less than $\sigma D/\rho$.

For $b/\rho = 0 \cdot 2$, [illegible] we find from [illegible]

$$M_1 = 1 \cdot 102\, D/\rho, \quad M_2 = -[\text{illegible}]\,997\, \sigma D/\rho.$$

It appears that the Bernoulli-Euler theorem can also be used with sufficient accuracy for finite deflections when [illegible] is not small.

Hindu College,
Delhi,
October 7, 1947.
B. R. Seth

1. Seth, B. R., *Phil. Trans.* [illegible] 1935, **234**, 244.

WHY IS THE OCEAN BLUE?

A NEW answer to this age-old question has been found as a by-product of some war-time research on the use of light rays in anti-submarine warfare. F. A. Jenkins (U. of Cal.) and I. S. Bowen (Mt. Wilson) in 1941 discovered that there exists in every cubic inch of clear ocean water about a million and a half dust-like particles, each about one fifty-thousandth of an inch in diameter. The suspended particles were discovered and counted with an ultra-microscope. These particles reflect sunlight back to the ocean surface. But the light that gets back to the surface has been filtered: water absorbs the red and yellow colours of light, leaving greens, blues, and violets, the combination of which is the indigo blue common to deep ocean water. Previously the explanation for this colour had been attributed to the scattering by molecules of water, just as the blue of the sky is explained by scattering due to air molecules. Less scientific explanations held that the ocean's colour was a reflection of the blue sky.

Jenkins and Bowen found that the billions of particles suspended in the ocean set a limit to penetration of light at 580 feet. This eliminated hopes of silhouetting submarines by dropping airplane flares below them, since it was impractical to use flares below about 200 feet. Scattering of light by the particles also prevented use of reflected light off submarines, similarly to the use of radio waves in radar.

—(Courtesy: *Bulletin of American Meteorological Society*, March 1947, p. 125.)

REVIEWS

Capacitors—Their Use in Electronic Circuits. By M. Brotherton. (Van Nostrand Company Inc., New York), 1946. Pp. 104. Price $3.00.

"This book is not a treatise on capacitors and neither depth nor originality is claimed," states the author in his Foreword to this useful little book. However, a perusal of it is bound to furnish useful hints regarding the use of these not-quite-understood circuit elements which are so essential in building up any electronic or communication equipment. Though its perusal may not make the reader an expert in the subject, it will help to remove a number of kinks in regard to understanding their behaviour and their subsequent successful applications in practical circuit design.

The book is divided into 9 chapters preceded by a very readable introduction and a summary of practical types of capacitors. Subjects discussed are stability, a.c. resistance, leakage, temperature characteristics and its effect on life of capacitors, etc., all from the view-point of a user. Capacitors using paper, mica, ceramic materials and air as dielectric as well as electrolytic types are each devoted a chapter though information about impregnated paper capacitors takes a major share. A few references to other works on the subjects are given for the more interested reader.

The book will generally be found useful as a quick and readable account of idiosyncrasies of various types of this essential electrical circuit element which is not always well understood and yet is always blamed for mishaps to electronic equipments, often out of sheer ignorance.

N. B. Bhatt.

Some Aspects of Red Cell Production and Destruction. *Annals of the New York Academy of Sciences*, 1947, Vol. XLVIII, Art. 7, pp. 577-704. Price $2.00.

In the above volume, eminent Hæmatologists have reviewed the recent work on the various aspects of the production and destruction of the red blood corpuscles.

Eric Ponder has dealt with the red cell cytochemistry and architecture and states that we are still in the stage of collecting observations and cannot expect to see more than the outlines of the picture. He points out that the components of either the surface structure or the internal structure or both are so arranged as to give the cell its characteristic biconcave discoidal shape. From observations on disc-sphere transformations produced by lysins, the shape-component may be considered to be a supporting ultra-structure, probably, but not necessarily, situated at the surface of the cell, and the permeability-component as being a layer or membrane, only a few molecules thick, situated somewhere in the thickness of the ultra-structure. The analytical data show that 40 to 60 per cent. of the lipid is bound to protein as lipo-protein with considerable differences in different species. There is good evidence that the thickness of the surface is not uniform. The region of the biconcavity is covered with a thicker structure with a greater protein content than elsewhere.

The possible relation between the various endocrine glands and Hæmopoiesis has been discussed by A. S. Gordon and H. A. Charipper. The supposition that the pituitary produces a specific hæmotrophic factor, they state, is open to question since various, already established, trophic principles have been found to display considerable erythrocytopoietic properties. There is no clear-cut evidence to indicate any role of the posterior pituitary in the erythropoietic process. A relation between the thyroid and erythropoiesis is suggested. Adrenal cortical hormones produce lymphopenia and neutrophilia. Evidence is presented to suggest that the gonadal secretions are responsible for the normal sex difference in red cell count detected in many species of animals. It is usually the male animal which reveals the higher red cell and hæmoglobin values. Further investigation is required to find out whether the hæmopoietic effects exerted by the various hormones are manifestations of their action on general phases of metabolism in the body or of their direct action on the blood-forming tissues.

F. S. Robscheit-Robins discusses the various factors affecting the hæmoglobin and red cell production in experimental hæmorrhage anæmia and points out the importance of diet intake, particularly of certain amino-acids, and iron reserves in the body.

S. Granick deals with iron and porphyrin metabolism in relation to the red blood cell. After describing the structural details of heme units, he points out that the iron required for the manufacture of the heme of the red blood cells is about 3·0 gm.: that is, about several hundred times as much iron is required for the red blood cells as for all the other body cells combined, excluding muscle hæmoglobin, and that specific mechanisms to ensure this supply have been developed in the body. It is interesting to note that a special mechanism exists for the regulation of iron absorption. The ferric iron is converted to ferrous iron by reducing substances in the food at the acid pH of the stomach. Ferrous iron entering the mucosal cells mostly in the region of the duodenum brings about a rapid accumulation of the specific protein, apoferritin, to which the iron attaches itself in the form of micelles of ferric hydroxide, the resulting compound being called "ferritin" discovered by Laufberger. In the mucosal cells, the ferric iron of ferritin is in equilibrium with the ferrous iron. The formation of ferritin helps to maintain the ferrous iron in a state of physiological saturation for several days, thus preventing the absorption of excessive amounts of iron. As ferrous iron moves out into the blood-stream, it is rapidly autoxidised to ferric iron, attaching itself to the β_1 globulin fraction of the serum. In this

manner, it is transferred to the liver, spleen, and marrow, where it may be stored as ferritin or directly utilised by the marrow in the synthesis of heme. We are still ignorant of why the iron brings about the accumulation of apo-ferritin; what enzymes are connected with the dissolution of iron from ferritin; and what enzyme systems are connected with the incorporation of iron into the protoporphyrin ring.

The author further deals with the mechanism of heme synthesis and chemistry of normal heme decomposition. He refers to the fundamental discovery of Shemin and Rittenberg (1945) that glycine labelled with heavy N is the nitrogenous precursor of the pyrrole ring. Acetic acid also appears to participate in this synthesis. Much yet remains to be learned as to how pyrroles are formed from glycine and acetic acid.

William B. Castle refers to Agren and Waldenstroem's recent report that an amino-poly-peptidase derived from hog gastric mucosa potentiates the hæmato-poietic activity of orally administered liver in pernicious anæmia and infers that the aminopolypeptidase presumably acts as the gastric (intrinsic) factor. The nature of the food (extrinsic) factor still remains uncertain. He further observes that purified fractions of liver extract possess distinctly greater activity in pernicious anæmia than does folic acid on a comparative dry weight basis.

William Dameshek reviews the literature on hæmolytic mechanisms and discusses the effects of hæmolysins and agglutinins, the passive nature of erythrostasis and the role of the spleen as well as such physical factors as cold, heat, hydrogen-ion concentration, etc.

This volume is of great value to students and workers in the field of Hæmatology.

B. T. Krishnan.

Van Nostrand's Scientific Encyclopedia. 2nd Edition, 1947. Pp. 1,600. £3-5 net.

This volume, like the previous one, is a mine of scientific information brought up to date both as regards the number of scientific subjects and the terms dealt with under each subject. There have been added to this edition new sections on Electronics and Radio, Metallurgy, Meteorology, Photography and Statistics. The sections on Aeronautics and Engineering sciences have been considerably expanded.

A particularly advantageous improvement in the facility of reference in this edition is the system of cross-indexing that has been developed. This enables the reader to collect easily the maximum of information that bears directly on all included topics. Every description is concise and perfectly lucid. The numerous illustrations make the comprehension of subjects still more easy. The meticulous care of the authors together with their cross-referencing, the small, neat print and the durable get-up have contributed in great measure to the inclusion of so much material within the covers of one volume. The reviewer, however, feels that the editors and publishers have been a little too ambitious in including such a vast number of scientific subjects in a single, wieldy volume. The natural consequence is that the *Encyclopedia* fails to fulfil its purpose of being exhaustive. A random sample survey showed, for instance, that [illegible] and Phosphatide are missing under chemistry, and phage, Bacteriophage, Salmonella and Glycæmia are not included among the medical terms. Interference, as an optical phenomenon, has not been described. Neither Insecticides nor Gammexane find a mention in the volume. An Engineer might miss quite a few in his subjects. Instead of trying to be so entirely comprehensive, it will be far more useful if the editors could plan two volumes, one for pure and the other for applied sciences. Such an effort has obvious advantageous.

Considering the volume of printed material in the book, errors are far too few indeed. The reviewer came across hardly two printer's mistakes—one (p. 63, line 37) [illegible] for [illegible], and the other, a little less excusable (p. [illegible], line 9), in the formula for pyrogallol [illegible] for [illegible].

We are confident that the famous publishers will bear these suggestions in mind and improve upon the present edition even as they have done on the last one.

With all the minor defects and omissions this is a 'must' reference book as the Americans call it, for every science library.

K. S. R.

Enzymes and Their Role in Wheat Technology. American Association for Cereal Chemists Monograph Series. Edited by J. Ansel Anderson. (Interscience Publishers, Inc., New York), 1946. Pp. 371. Price $4.50.

This volume is the first of a projected series of monographs sponsored by the American Association of Cereal Chemists "primarily as a service to its members". The book starts off with a good chapter on the general chemistry of enzymes. Then follow twin chapters for each of the particular enzymes—amylases, esterases, oxidases, proteases and the fermentation enzymes, every chapter being written by a specialist. In the first of these twin chapters a fairly general treatment of the enzyme concerned is given, while the second chapter is meant to be a discussion on the part played by that enzyme in wheat technology. Each chapter comprises a bibliography, besides the usual author and subject index at the end of the book.

Although an avowed purpose of the book is its emphasis on the role of enzymes in wheat technology, the elaborate treatment of the pure chemistry of enzymes appears rather out of balance in the book. The editor is not altogether unaware of these faults. Here is his apology: "With several authors involved . . . . a certain amount of overlapping is difficult to avoid." It is still difficult to understand the inclusion in the text of any treatment on enzymes that have no or very doubtful role in wheat technology. Chapter V on esterases is just a case in point, best illustrated by the following remarks of the author of this chapter (p. 153): "The esterases of plants have not been investigated as extensively as the amylases and the proteolytic enzymes and, therefore, a discussion of the function of the esterases as applied to milling and baking problems is

necessarily limited" and "... since data in this field are no meagre, it will be necessary to borrow freely from research done on other enzyme sources, both plant and animal."

If there were an International Board of Editors, rigidly regulating the publication of technical books in strict conformity with current needs and economy standards, it is doubtful whether the book would be passed as it is.

But all this is not to deny the excellent get-up of the book and the profundity of certain of the chapters on the pure chemistry of enzymes, notably those on oxidases and proteases. It is hoped that the less initiated wheat technologist will find himself able to drink deep at this well of knowledge.

S. N.

Methods of Vitamin Assay. Published for the Association of Vitamin Chemists, Inc., by Interscience Publishers, Inc., New York, 1947. Pp. 189. Price $3.50.

The difficulties felt even by the experienced analyst in vitamin assays in natural products are in no small measure due to the lack of a single co-ordinated procedure for the analysis of a particular vitamin in a given material. The methods gathered from literature and adopted, vary very widely for the different materials, and the accuracy of results obtainable by each being doubtful, the analyst is usually thrown back on his own resources to select the procedure best suited to him and devise his own modifications. Much of the confusion is due to the omission of necessary details of procedure in the technique. The analytical methods showing specificity to the operators is also a common experience, even to the skilled analyst, when methods reported to be applicable do not give concordant results at his hands. The literature on analytical procedure for vitamins is vast and varied. Every vitamin analyst must have felt how welcome it would be to have on hand a publication containing a detailed description of the tested and authentic analytical methods for vitamins in different materials.

In publishing this handy manual the editors have satisfied a long-felt need, an din their treatment of the subject have shown real appreciation of the difficult task they have undertaken and have conspicuously succeeded in bringing out a work of merit.

The book under review is the result of collaborative effort of the Association of Vitamin Chemists, founded in 1943, with the co-operation of experts from scientific laboratories all over the country. The various methods for the assay of different vitamins described in the book are those which have been verified by collaborative assay.

The important aspects of the sampling, preliminary treatment and methods of calculations are given in the commencing chapter. Detailed description of standard methods for assay and calculation for the vitamin A and its precursor, vitamins B_1 and B_2, Niacin and ascorbic acid are given in the following chapters. The rest of the vitamins for which critically evaluated methods are not yet available are listed in the eighth chapter with references to literature. In the concluding chapter the use of check samples in control of vitamin methods and the preparation and storage of the samples used in standardisation of methods are discussed. Wherever details are necessary for accuracy, emphasis has been laid on them and explanation given at length.

A notable feature in the various chapters is the detailed notes on each method together with a complete list of apparatus, chemicals and working of instruments used in the analysis. Reference to literature at the end of each chapter adds to the usefulness of the book. Perhaps inclusion of a list of vitamin contents of natural products would have been a welcome feature.

C. N. Bhima Rao.

Annual Review of Biochemical and Allied Research in India, Vol. 16, 1945. (Society of Biological Chemists, Bangalore, India.) Price Rs. 3.

The present issue of the Review, like the previous ones, comprehensively reviews the researches in Biochemistry including the related aspects of medicine and nutrition in India. Giri and Das have summarised the work on Enzymes, describing in some detail new methods of estimation of enzymic activity, and of biological constituents with enzymes. Researches carried out in 1946 have also been included in this section. Bashir Ahmed and Vohra have brought together the work on the various vitamins. The finding that shark liver oil derived from low pressure extraction is far less rich in vitamin A than steam-extracted oil promises scope for further work, and the fact that calciferol, as a substitute for ergosterol, fails to support the growth of certain larvæ perhaps explains why calciferol sometimes fails as a cure for human ricketts. It is also noteworthy that the symptoms of ascorbic acid deficiency might manifest themselves in the form of pseudoparalysis in the absence of scurvy.

Ranganathan's review on general Nutrition draws attention to the importance of careful and correct presentation of scientific findings to the public as, otherwise, wrong notions (like cooking in copper vessels to preserve vitamin C in food) on an important subject might take root in the minds of lay people. Gross deficiencies in protein, fat, meat and milk in the Indian diet have been stressed as usual, and references have been made to suggestions for ameliorative measures.

A notable observation in nutrition is that while casein and calcium lactate either singly or together exert a growth-promoting effect on a predominantly carbohydrate diet, butter alone has an adverse effect, but together with casein exerts a beneficial effect. This naturally indicates either that casein makes up, as the workers have suggested, a factor deficient in rice for the utilisation of dietary fat, or serve to counteract a possible inhibitory effect of butterfat. In this connection, it is not quite correct to state that calcium lactate is an ingredient of milk, for most of the calcium in milk exists in combination with protein, and not at all as a salt of lactic acid.

The changes in the content of the vitamins of the B complex on souring milk

are of significance in the Indian dietary wherein soured milk generally finds a place. Ray has briefly enumerated the year's findings in Animal Nutrition, and Basu has resented a critical summary of the work on Metabolism. In the latter section tapioca is consistently misspelt as *topioca*.

It is felt that if the entire work on Nutrition had been critically reviewed either by the same reviewer or by the different reviewers in collaboration with each other a more cogent and comprehensive picture of the subject in a single perspective could have been presented.

Study of normal movement of the colon of apparently healthy Indians, Europeans and Anglo-Indians by Moller shows that it is faster in Indians than in Europeans. There was no difference in pulmonary tuberculosis unless there was evidence of involvement of intestines in which case there was hypermotility. Chakravarty has found urea, non-protein nitrogen, chloride and cholesterol in the blood of young adult Bengalis lower than in those of non-Indians and those of people of Bombay province. Using Russell's viper venom as a source of prothromboplastin Rahman and Giri found average prothrombin time for healthy blood to be ten seconds, which was found to be prolonged in tuberculosis, malaria, jaundice and anæmia. It is significant that they found no relationship between plasma prothrombin and serum calcium. The important role of dietary histidine in regeneration of hæmoglobin and R.B.C. has been shown by Yeshoda. Repeated multiple pregnancies neither elevate blood pressure nor cause a rise in incidence of toxæmia. The toxic factor in earlier pregnancy is unknown. This is shown by Corary's work among rural women in Ceylon. Even among individuals of the same race blood group distribution is influenced by environmental factors as shown by Mazumdar's work.

Antibacterial properties of two compounds related to merthiolate were studied by Bhattacharya and Gupta. Dharmendra and Mukherjee found sulpha pyridine and sulphanilamide lethal to *B. lepræ muris, in vitro,* but failed to cure the infected animals. Bose describes a powerful non-toxic antibiotic against Oxford strain of *S. aureus, B. typhosus* and *V. choleræ.* He isolated it from the filtrate of the culture of polyporus. Lactones having anthelminthic properties have been prepared by Paranjpe and others. Ahuja and Brooks claim success in their method for estimation of antihæmolytic titre of cobra antivenene. Bose and Ghosh have described an easier and reasonably satisfactory method of assaying adrenaline solutions in guinea-pigs.

The chemical method of assaying anthrocene purgatives evolved by Ghosh and others is claimed to be better than bioassay. Sahasrabudhe has made an interesting observation on œstrogenic activity in lipase obtained from defatted castor seeds. But he does not say whether olive oil, which he used as solvent for lipase, is free from that activity. Bose and Mukerjee have found that the narcotic properties of hemp resin-charas in the alkali-insoluble fractions, whereas soluble fractions were inactive. The alkaloidal content of Indian lobelia is reported to be greater if collected in suitable localities during October-November. The ether extract alone is of doubtful therapeutic activity. Chopra and others have isolated an alkaloid from *Inula roylena.* Some of the alkaloidal bases of argemone oil, a common adulterant of mustard oil, are suspected to be the possible causative agents of Epidermic dropsy. Ranganathan could not find any correlation between toxicity and solubility of fluorides, because magnesium fluoride which is insoluble in water is more toxic than soluble sodium or calcium fluorides. He has reported the mitigating influence of calcium in experimental fluorosis.

Panja and others have found sweet and sour curds similar in bactericidal action on *V. choleræ, B. typhosus* and *B. dysenteræ.* Lactic acid was found to be chiefly responsible for this action. Panja has described an easy method of obtaining a rough variant of *V. cholera* by adding a small fraction of atebrin to the culture medium. Owing to the frequent occurrence of *B. paratyphosus* and *B. enteritides* infection the advisability of incorporating these organisms in the prophylactic typhoid vaccine is suggested. Menon's observation of the coexistence of *G. Intestinalis* and *Fuso spirochætes* in some obscure cases of diarrhœa deserves further study. In a critical study of eight cases of "tropical Eosinophilia" it appears that the syndrome is of an infective origin, although some observers consider it an allergic phenomenon. No evidence of toxicity was observed in a series of 24 cases of serum transfusion where nearly 1,000 c.c. of the serum was transferred. Cardiovascular and other changes in a group of fifty cases of diabetes were studied by Chakravarty. A number of modified media for easy identification of intestinal pathogenic organisms have been described by various workers. A useful technique by flotation with copper sulphate solution for concentrating *E. histolotica* cysts has been described. By the incorporation of 200-1,000 units of penicillin in the culture medium, *L. tropica* was isolated from skin cultures free of staphylo and streptococci. The unsuitability of white mice for the study of liptospiosis has been noted by Lahri and Das Gupta. An interesting case of splenic cyst due to malarial enlargement and subsequent atrophy of splenic pulp has been described. Veeraraghavan's finding of a protozoal parasite in the central nervous system of animals suffering from rabies is a revolution in the idea of the etiology of rabies. The method of cultivation of the brain of suspected cases of rabies is described by the author as a surer and quicker method of diagnosis. An effective polyvalent antisnake venom serum useful against all the common snake venoms of India has been prepared by the Haffkine Institute. The serum is available in lyophetised form which can be stored in ordinary condition without affecting the potency for a considerable time. Improvements in the serological test for diagnosis of typhoid fever, Kala-azar, cholera and lyptenhis are described by different authors.

Billimoria and Jacobi have investigated the relationship between tuberculosis and carbohydrate metabolism by sugar tolerance test. A case of tuberculosis lesion of the cranial bone which is rare has been described.

K. S. RANGAPPA.
K. P. MENON.

SCIENCE NOTES AND NEWS

International Geological Congress

The Eighteenth Session of the International Geological Congress, originally planned for 1940 and postponed on the outbreak of war, is to be held in Great Britain in 1948, on the invitation of the Geological Society of London.

Sessional meetings will take place in London from August 25th to September 1st, 1948.

All communications should be addressed to the General Secretaries, Eighteenth Session International Geological Congress, Geological Survey and Museum, Exhibition Road, London, S.W. 7.

Two New Technical Schools for India

The Most Reverend Louis Mathias, Archbishop of Madras, announced in New York on November 15th that the Roman Catholic Church was planning to help India's industrialisation programme by opening two technical schools to train Indian technicians in various engineering fields and allied sciences. He said the schools will cost $250,000.

Rev. Mathias arrived in America in November to obtain used machinery and other equipment as well as funds for the project. He said the schools, which will be in the City and suburbs of Madras would be open to all faiths "to train the youth of India for the vast responsibilities which are to be theirs in the future".

Indian Institute of Metals

The Indian Institute of Metals will be inaugurated on December 29th at the Royal Asiatic Society's Hall by Dr. Syama Prasad Mookherjee, Minister for Industry and Supply.

The Institute has been founded by leading metallurgists in India with the object of promoting and advancing the study and practice of the science and technology of making, shaping and treating metals and alloys. The Institute has among its members highly qualified metallurgists who have specialised in the various branches of metallurgy.

Sir J. J. Ghandy, Director, Tata Industries, Ltd., has been elected first President of the Institute and will deliver his presidential address at the inaugural meeting.

A Carnegie Grant

The Cornell University has announced the receipt of a 180,000-dollar-grant from the Carnegie Corporation of New York, to investigate the impact of modern agriculture, science and industry on such areas as India, the Far East and Latin America.

The President of the University, Mr. Edmond E. Day, said that the fund will be used in a programme of research and instruction in which anthropologists and other scientists will study contemporary problems.

The findings will be used at Cornell in special training courses to prepare interested American and foreign students for work in these regions.

Scientific Research in U.P.

The Committee appointed by the U.P. Government for the promotion and encouragement of scientific research in universities and elsewhere in the province will be presided over by Dr. K. S. Krishnan, Director, National Physical Laboratory, Government of India. The first sitting of the Committee will be inaugurated by Mr. Sampurnanand, Education Minister.

In setting up this Committee the Government have no intention of interfering with the freedom of research in universities. The Government have provided a sum of Rs. 50,000 in the budget under education for the current financial year for financing researches not conducted by the universities. A sum of one lakh has also been provided in the budget for the current year for giving assistance to universities towards conducting research in science.

Applied research will be undertaken at the Committee's own initiative or at the instance of private individuals or firms. In the latter case the party concerned will be required to make such contributions as the Committee may consider necessary.

Telephone Manufacture

Plans for setting up a new telephone plant factory in India are reported to be complete by the Government of India. The new factory is likely to be established in Bombay where a factory for the manufacture of telephone apparatus and parts already exists. The new plant-manufacturing factory is intended to meet the increasing needs of the automatic telephone system which the Government of India propose to introduce throughout the country.

The project is expected to cost the Central Exchequer seven crores of rupees and is likely to be completed in three years' time.

Intermediate for Dyes and Developers

2, 4-Diaminophenol obtained by the reduction of *m*-dinitrobenzene, a valuable intermediate required for photographic developers of the 'Amidol', 'Diamol' and 'Dolmi' class, and of dyes employed in the dyeing of furs and hair, has been prepared in good yields in the laboratories of the Presidency College, Madras, by the electrolytic reduction of *m*-dinitrobenzene in sulphuric acid emulsion using a copper or monel cathode and a lead anode in the presence of mercuric and ceric sulphates. In simplicity and economy of operation and low upkeep charges, the process is reported to be superior to other processes.

Vegetable Oil for Diesel Fuel

Investigations carried out under the auspices of the Council of Scientific and Industrial Research have shown that most of the Indian vegetable oils can be successfully employed as Diesel fuels. Cotton seed oil, in particular, gives exceptional performance in that its consumption is definitely less than that of mineral oils. Despite their good performance, however, vegetable oils cannot compete with mineral fuels because of the high price. If vegetable oil could be used as a vehicle for powdered solid fuel, the resulting fuel will be cheaper than the oil and may be able to compete with the mineral oil. This possibility has been tested in the laboratories of the Council. The results show that with the use of a stabilizer prepared from the oil itself, colloidal fuels containing as much as 35% by weight of charcoal can be prepared and stored for lengthy periods without the charcoal settling down. Provided the injection system is replaced to suit the new fuel, a thermal efficiency approaching that of groundnut oil can be attained, the charcoal part being burnt as efficiently as oil itself. For this to be possible the charcoal should be reduced in size to about 2μ and the injection system should be redesigned.

Important Mineral Finds in Mysore

Applying the geophysical techniques, the Geology Department in Mysore has discovered a promising pyritiferous ore body at a depth of 80′ below the surface at Guddarangavvanahalli and another in Ingaladhal, both in the Chitaldrug district. The latter is estimated to yield about half a million tons of pyritic material with a sulphur content varying from 25 to 42 per cent. in an area of about 100 acres so far surveyed. The ore can be utilized for the manufacture of sulphuric acid.

A large body of graphite schists estimated to yield 50,000 tons of the ore at a depth of 10-15 feet below the surface and suitable for pencil making, lubricants, paints, foundry facings and electrodes, has also been discovered.

Indian Forest Ranger College

The Report for the year 1945-46, of the Indian Forest Ranger College, Dehra Dun, which has been published after a lapse of four years, shows that the College expanded by fifty per cent. during the year, to meet the demand for trained Forest Rangers.

The two-year course at the College includes teaching of Silviculture, Forest Protection, Forest Management, Forest Mensuration, Forest Utilisation, Forest Law and the allied subjects such as Forest Botany, Forest Pathology and Mycology, Forest Entomology, Forest Engineering, Geology, Soil Science and Forest Surveying. In addition, extensive tours are made to forests in many Provinces to impart practical training.

Award of Doctorate

The D.Sc. Degree of the Andhra University has been awarded to Mr. J. Venkateswarlu for his thesis on "The Morphology of Martifloræ with Some Observations on the Nyctaginaceæ."

Mr. P. Venkateswarlu, M.Sc., has been awarded the D.Sc. of the Benares Hindu University for his thesis on "Molecular Spectra of the Halogens".

World Committee on Malaria

Dr. D. K. Viswanathan, Assistant Director of Public Health, Malaria, Bombay Province, has been appointed by the Government of India to be a member of the Expert Malaria Committee of the Interim Commission of the World Health Organisation.

Dr. Viswanathan will visit the U.S.A. in the near future, to attend the meeting of the expert Malaria Committee in Washington in May 1948, and to study the methods of health publicity followed in that country. He is also being deputed by the Government of Bombay to the Congress of Tropical Medicine.

A New Pest of Jute

Ferrisia virgata CKII (Coccidæ), a fairly common mealy bug in India, has recently been recorded as a pest of jute (*C. olitorius*), particularly on these plants which were under selfing covers for experimental purpose in the Dacca farm of the Indian Central Jute Committee. The damage is mostly caused by the nymphs which usually remain congregated around the mother and suck up the sap of the stems, pods, fetioles and leaves. The female has a pair of long white caudal filaments, her whole body covered with white powdery meal and cottony hairs, and can lay as many as one thousand eggs in course of two or three days after which she dies.

Foam for Fighting Fires

Large petrol fires cannot be fought with the usual fireman's water jet, because the petrol floats on the water and continues to burn. Foam is lighter than petrol and it can form a blanket on top of the petrol and so extinguish the flames. The type of foam largely used in Britain is called mechanical foam; it is produced by churning up air and water with a foam stabilising agent.

The most suitable agents are chemical breakdown products of hoof and horn meal, or glue mixed with materials similar to soapless shampoos or chemically treated blood. The latter is a waste material from abattoirs.

The new foam compound is said to have the additional advantage of a much lower viscosity than other types and so it could be used without modification in R.A.F. crash tenders. It produces a high efficiency foam for combating aircraft fires.

Details of the researches on fighting petrol fires with foam are published in *Chemical Research Special Report, No. 6.—A Study of Mechanically Produced Foam for Combating Petrol Fires* (H. M. Stationery Office, London).

A Photoelectric Hygrometer

An instrument that measures small absolute humidity changes by the photoelectric examination of the 9,400 Angstrom units absorption

band of water vapour is described in the *Bulletin of American Meteorological Society* (September 1947). The instrument consists of a small source of light which sends its radiation over an air path of less than one and a half metres to a dispersing system. The resulting spectrum then is allowed to fall on two vacuum phototubes; one centered in the 9,400 Angstrom units absorption band of water vapour, the other located at 8,000 Angstrom units where no water vapour absorption bands exist. As the absolute humidity in the air path is varied, the phototube in the region of the band is affected; whereas the reference phototube is not. The phototubes are arranged in an amplifying circuit so as to magnify the effect of varying humidity. The instrument uses a portable mocroammeter instead of the sensitive galvanometer of all previous spectral hygrometers. Humidity changes of 2 to 8×10^{-5} centimetre of precipitable water-path over 143 centimetres of air path can be measured. An investigation of the small sensitive range of the instrument was carried out and the results indicate that the device is confined to use over a small humidity range with equipment available at the present time.

Diet and Tumour Growth

Experiments on the incidence of cancer and other neoplasms show that caloric restriction of the diet inhibits the genesis of all types of mouse tumours that have been studied, namely, induced skin tumours and sarcomas, spontaneous mammary carcinomas, lung adenomas, hepatomas, and spontaneous and induced leukemia. Fewer mice develop tumours, and these appear at a later time on restricted colloric intake. It is thought probable that the main influence occurs during the development of the tumour rather than during the preparatory stage.

Among human beings, analysis of mortality records of insured persons reveals that individuals who are overweight when past middle age are more likely to die of cancer than are persons of average weight or less. Coupling these results with those obtained with mice, it is concluded that the avoidance of overweight might result in the prevention or at least delay in the incidence, of a considerable number of cancers in human beings.

Cystine and choline in the diet have also been found to influence tumour growth. While a diet restricted in cystine reduced the incidence of leukemia, choline-deficient diet caused neoplasms.

—(*New York Acad. Sci.*, Vol. 49.)

Locating Cable Faults

Early and precise location of a fault in a cable is an essential factor in any efficient telegraph or telephone system. Britain's Post Office radio engineers working on the problem have developed a fault-locator which is based on the same principles as those applied in radar.

This new fault-finder, known as a pulse locator, comprises a cathode-ray tube detector, and it transmits a high frequency pulse over a cable. The pulse is reflected back from any obstruction due to a fault. The time taken by the pulse to travel to and from the fault is measured on an oscilloscope. From this is calculated the distance to the fault.

This pulse locator is outstanding for the clarity and reliability of its indications, particularly when more than one fault is present. Faults on co-axial cables which contain co-axial tubes, each pair of which can carry several hundred simultaneous conversations, can be located within one per cent. of their true distances at ranges up to ten miles.

Publications Received

The Indian Sugar Industry (1946-47 Annual), Vol. XII, November 1947. Rs. 6. Editor M. P. Gandhi.

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Indian Forest Records (New Series), Vol. 3, No. 7, 1945 · (Published by the Forest Research Institute, Dehra Dun, U.P.). Price Rs. 5-12.

The Role of Glaciers and Snow on Hydrology of Punjab Rivers. By Kanwar Sain. (Published by the Central Board of Irrigation, Simla.)

Procedings of the Royal Physiographic Society at Lund, Band 16, 1946.

Report of the Indusrial Delegaion. (A.I.M.O., Bombay), 1947.

ERRATA

Vol. 16, No. 11, November 1947, p. 343, Note on "The Colouring Matter of *H. esculantus*":

Column 1, para 1, last sentence: *Delete* "One of the varieties of" and begin the sentence with "The".

Para 2, line 17: *Read* "230-32°" *for* "230-320 ° C."

Column 2, para 1, line 8: *Read* "yellow-green-blue" *for* "yellow green blue".

Para 2, line 1: *Read* "was" *for* "is".

Vol. 16 Page	Subject	Portion	Para	Line	
139	"Abnormally dry etc"	Left	1	5	*read* well-distributed *for* well-disturbed
	,,	Right	1	16	*read* of *for* or
174	"Air mass etc."	Left	1	8	*read* moist layer *for* coist
175	,,	Right	5	16	*read* air can be made easily unstable *for* air is unstable
245	"Abnormally heavy rainfall etc."	Left	1	26	*read* a satisfactory theory *for* data
	,,	Right	3	4	*read* comes *for* come
247	,,	Right	1	12	*read* strong winds only below 1·5 to 2·0 kms. even on a good monsoon day *for* such variations

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